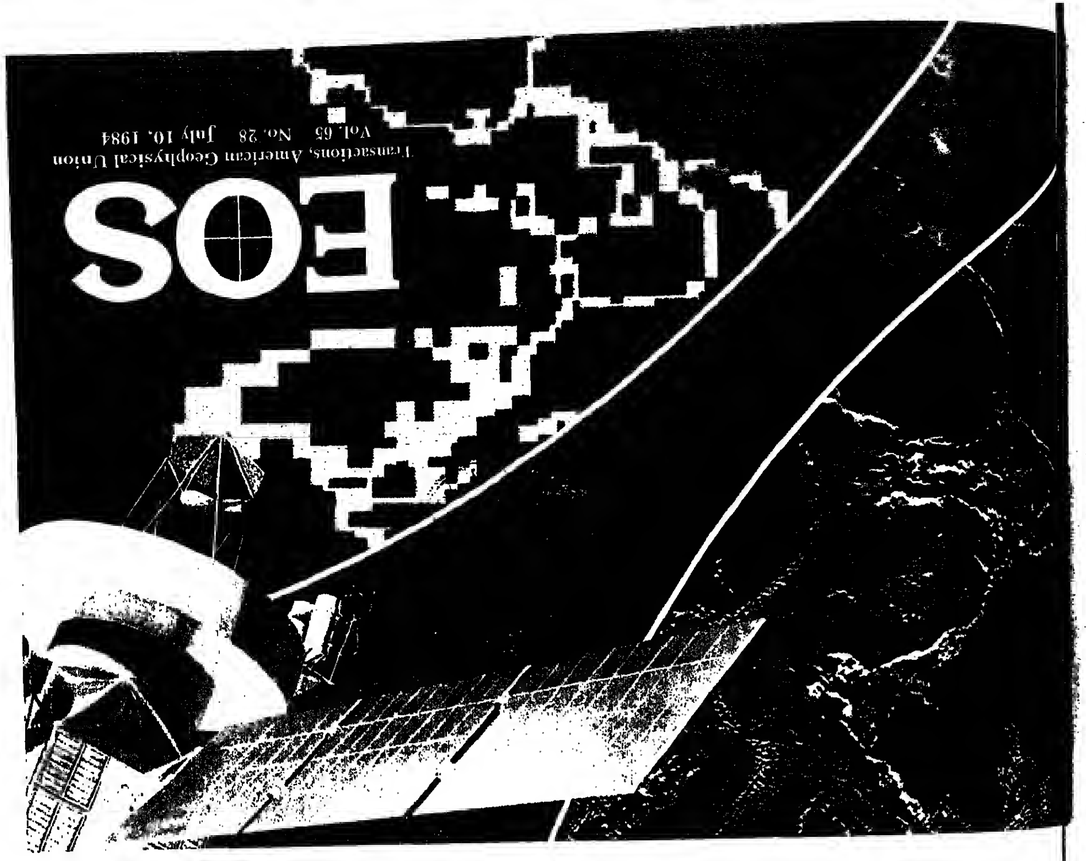

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Particles and Fields—Magnetosphere

9733 Magnetic storms
ENERGETIC ION MASS COMPOSITION AS OBSERVED AT NEAR-GEOSYNCHRONOUS AND LOW ALTITUDES DURING THE STORM PERIOD OF 21 AND 22 FEBRUARY 1979
R. J. Strangeway (Institute of Geophysics and Planetary Physics, University of California, Los Angeles, California 90024) and R.G. Johnson

Mass composition data acquired from the near geosynchronous SCATHA spacecraft and the polar orbiting S3-3 spacecraft at altitudes below 8000 km during the storm period of 21 and 22 February 1979 are presented. The data from both spacecraft show that significant amounts of ionospheric plasma were observed to be injected around the main phase of the two storms on 21 February 1979. The S3-3 data show that the density enhancement in the plasma population moved to progressively lower L-shells during the recovery phase of the storms. As it is unlikely that the plasma is injected at the point of observation, at least during the recovery phase, we consider drift effects to be responsible for this signature. We have employed a steady state convection model to study drift effects during the recovery phase of the storm. Since we consider shielding to be important only later in the recovery phase, it is further assumed that the cross-tail electric field is uniform. On comparing the data with the convection boundaries we find that we can usually choose a cross-tail electric field strength which models the particle signatures quite closely. We consequently find that the apparent movement to lower L-shells of the density enhancement during the recovery phase is due at least in part to drift effects on ion energy plasma population at these L-shells (below L=4). Time of flight also implies that these ions were in the morning local time sector at the time of the main phase of the storms. At the same time that these ion energy long drifting eastward are observed, large numbers of ions convecting westward are also seen. This plasma population contains a large amount of ionospheric plasma. Furthermore, the ionospheric plasma as labelled by singly charged oxygen appears to have been injected over quite a large range in local time during the disturbance. On the other hand the protons signatures imply that most of the protons observed at the higher L-shells were confined to the nightside sector during the main phase of the storms. While there are many similar features associated with the second storm in the S3-3 data, the oxygen ions display a signature consistent with injection only in the nightside magnetosphere. This is in agreement with the SCATHA observations where the particle spectra show multiple dispersion signatures. (Mass composition, magnetic storms, plasma convection).

J. Geophys. Res., A, Paper 4A0918

5736 Magnetic Tail
CHARACTERISTICS OF PLASMOIDS IN THE DISTANT MAGNETOTAIL
M. Scholer, (Max-Planck-Institut für Physik und Astrophysik, Institut für extraterrestrische Physik, 8046 Garching, FRG), G. Gloeckler, D. Hovestadt, B. Klecker, and F. M. Ipavich

The average characteristics of 29 energetic particle burst events in the distant geomagnetic tail have been determined. The measurements were made with two particle sensors of the Max-Planck-Institut/University of Maryland experiment on ISEE-3 during the recent Geotail Mission. The events are characterized initially by bi-directional streaming electron distributions which are followed by isotropic distributions. Assuming that the energetic protons (>30 keV) are connected with the local plasma flow (and not convected sideward) we can determine the flow speed from the measured angular distributions and the differential energy spectral shape. We find that the average velocities range from ~ 300 to ~ 1000 km/s. The size of these structures, most probably plasmoids, along the convective flow direction is observed to be between ~ 20 and ~ 100 Rg in most of the cases, with a mean value of ~ 80 Rg. The energy spectra (in the plasma frame) are consistently steeper than power law, being closer to exponentials in energy. The differential proton intensity in these events, on the average ~ 500 cm²cm²s sr keV at 30 keV, is in order of magnitude smaller than in the near-earth plasma sheet.
J. Geophys. Res., A, Paper 4A0900

5743 Magnetospheres
LARGE SCALE FLOW IN THE DAYSIDE MAGNETOSHEATH
R. D. Crooker (Departments of Atmospheric Sciences, University of California, Los Angeles, CA 90024), C. T. Russell, T. E. Eastman, L. A. Frank, and R. D. Zwickl

The degree of control over plasma flow direction exerted by the compressed magnetic field in the dayside magnetosheath is examined by comparing ISEE 3 LEPEDEA data with hydrodynamic and magnetohydrodynamic predictions. Measured flow directions projected toward the subsolar region max within ~ 1 Rg of the aberrated theoretical hydrodynamic stagnation point in 11 of 28 cases examined. The maximum departure is within ~ 2-3 Rg of the stagnation point. Only cases with large deflection max have been studied in detail with high-time resolution plasma and magnetic field data both from ISEE 1 and from ISEE 3, in the vicinity of a solar wind monitor. The deflected flow is persistent over periods of 1-10 hours, and its direction is consistent with a stagnation point displacement resulting from increased, asymmetric magnetic field pressure/constant solar wind ram. Particle data also show much smaller, as predicted by Spreiter et al. Of the other 8 cases with large deflections, four are accelerated flows, two are transient streams identified independently by Sanchez and Russell. The observed deflections in these cases are consistent with the molecular scrolling line of the stagnation point hypothesis, but not exclusively with one of its consequences, the formation of a region of flow reversal rather than a stagnation point at the magnetopause (Spreiter boundary, stagnation point, flow reversal).
J. Geophys. Res., A, Paper 4A0697

5780
HIGH ENERGY PROTON DRIFT ECHOES - MULTIPLE HIGH STRUCTURE
R.D. Belian (Los Alamos National Laboratory, Los Alamos, NM 87545), D.N. Baker, E.W. Hones, Jr., P.R. Higbie

Many high energy proton drift echoes observed in association with magnetospheric substorms exhibit multiple fine-structure peaks during the course of one or more of the echoes. Because of the difficulty in distinguishing between temporal, positional, pitch-angle selection, and gyrophase effects with instruments on a single satellite the identification of these as individual particle features as opposed to statistical variations in proton intensity or other effects) has not been convincingly established heretofore. We here present an energetic ion data from similar instruments on three widely spaced geosynchronous satellites with the goal of resolving whether or not these multiple peaks are a persistent feature of the injection process. Our results support the multiple peaks are indeed a real feature of the injection process. Our results support the conclusion that at least three-quarters of the ion enhancements that result in drift echoes are made up of multiple-peaked events. A very good correlation between the onset of the various peaks and detailed features observed in high latitude magnetograms is also observed, leading to the pairing of peaked events. In fact, in their relation to the magnetograms, there seems to be a pairing of pulses, that is, with each dip in the magnetogram there appears to be two associated ion pulses. Various possible models for the ion bearing multiple peaks, including the ion bearing magnetic field in the plasma sheet, magnetic instability in the plasma sheet, and/or, mirroring effects, temporal and/or positional effects of multiple neutral line formation, and effects due to different ion species are discussed.
J. Geophys. Res., A, Paper 4A0872

5770 Short-period variations of magnetic field
SPECTRAL CHARACTERISTICS OF PC 3 ASPO PC 4/5 AMBIENT FLUCTUATION BANDS OBSERVED NEAR L=8
T. Yanagisawa (Department of Aeronautical Engineering, Kyoto University, Kyoto 606, Japan), H. Fukunishi, Y. Hiraoka, A. L. McPherron, T. Saito, and Y. Zero

From dynamic spectral analysis of magnetic pulsations observed at auroral-zone stations near L=8, it has been found that there are two broadband spectral bands throughout the year in the Pc 3 and Pc 4/5 frequencies of ~20-80 mHz and ~2-10 mHz, respectively, range with frequencies at ~20-10 mHz. At geosynchronous orbit, corresponding spectral bands are observed by the ATS-6 satellite's component with a horizontally oriented magnetometer. The ATS-6 satellite was located at the geomagnetic equator at L=6.6 and was in the 2-10 mHz band in the afternoon sector. The 2-10 mHz band is considered to be the second mode of standing shear Alfvén wave oscillation in the dipole field line between conjugate ionospheres. However, both bands have been observed sometimes on the ground at middle latitudes between both bands and frequently in the 20-80 mHz band especially during quiet days. This result indicates that the 20-80 mHz and 2-10 mHz bands are excited by the same source mechanism and Pc 4/5 bands are excited by different magnetospheric oscillation sources. It is likely that the 20-80 mHz band is the second harmonic range of the external driving source and the 2-10 mHz band is the fundamental range. This driving source may be a standing Alfvén wave near L=6, while the second harmonic range is in the Pc 3/4 range. The present observations indicate a fundamental mode.
J. Geophys. Res., A, Paper 4A0834

Personal Seismometry Now!

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This article discusses the possibility of personal seismometry (i.e., seismologists having direct access to seismometer installations even from their studies at home). The basic ingredients for this are the general availability of relatively inexpensive microprocessors and easy access to a switched telephone network or equivalent communication systems. Finally, an experiment is described by which seismological data were exchanged between a temporary installation in the United Nations restaurant in Geneva and data center facilities in Oslo, Trondheim, Washington, D.C., and also Canberra.

Introduction

Recent advances within the fields of microprocessor technology and telecommunications already have had a great impact on industrialized societies. The essential elements of this process are that both manual and parts of mental skills can be transferred to and administered by computers in one form or other. Also, with the same ease and by the same means as people can talk with each other across continents via (oral) phone connections, the same applies to two computers. The revolutionary thing here is that this can be achieved by means of cheap, generally available microcomputers and ordinary modems connected on standard telephone line outlets.

Scientists have in general been very keen on taking advantage of advances in computer technology, that is, to use large mainframe computers for solving problems of complexities hardly imagined just a few decades ago. In other aspects of science, like automated data recording, analysis, transfer, and communication within the scientific communities, widespread computer usage has generally been slow to emerge. Notable exceptions here in the field of geosciences are meteorology and seismic exploration whose services are generally rated as crucial to society. A few illustrative cases are as follows: A seismic profiling ship may, under a month-long cruise, collect trillions of bits of data in a automatic and sophisticated mode. In meteorology, where international cooperation is a prerequisite, a global communications network has been established for exchange of traditional meteorological data. These examples serve to illustrate the point that huge amounts of data can be handled satisfactorily with a modest expenditure of manual work. A paradox here is that in other geoscience branches like seismology, two to three persons may literally make a living operating a single seismograph station the data output of which in many cases amounts to report P wave onset times for a few hundred earthquakes annually.

In this article we will describe some experiments that are meant to demonstrate that the highly efficient data recording and processing systems that are/were the hallmark of the large aperture arrays NORSAR and LASA can be adapted in even very small seismological observatories with modest costs; in the extreme case, a seismologist could operate his (or her) own mini-array (from his (or her) study room at home.

Seismometry Evolution

The first seismographs, pendulum seismometers with smoke paper recording, were installed in Japan about 100 years ago [*Dewey and Byerly*, 1969]. The early invention by Count Galitzin of the electromagnetic seismometer in 1906 laid the foundation for engineering development for the modern electrodynamic seismograph. However, up to the 1950's the design, construction, deployment, and operation of seismograph stations were generally academic undertakings and as such were inadequate concerning tasks like monitoring potential clandestine underground tests of nuclear weapons and tsunami warnings. Also, the amount and quality of seismogram data available at that time were clearly insufficient to match theoretical advances. For these and other reasons, the U.S. Coast and Geodetic Survey embarked on a seismograph development program [e.g., see *Melton*, 1981 a, b] which culminated with the global deployment of some 100 high sensitive standardized seismograph stations, part of the VELA Uniform Program of the United States. A unique feature of the system—the so-called WWSSN network—was the great care taken to ensure that the data recorded were (and are) available to the seismological community at large.

Parallel to the deployment of WWSSN stations was the construction of the first experimental arrays in the United States and the United Kingdom, that is, clusters of closely spaced seismometers and integrated recording systems. The really bold concept here was the installation in the late 1960's of the large aperture arrays LASA (Montana) and NORSAR (S. Norway), where the output from hundreds of seismometers was centrally recorded in digital form and automatic on-line and off-line processing schemes were employed [*Ringdal and Husebye*, 1982]. Also, many other countries, notably Canada, France, Japan, Sweden, United Kingdom, and USSR have deployed networks of standardized seismograph stations partly for monitoring local earthquake activity [*Lee and Stewart*, 1981].

The present stage of seismometry development is dominated by the U.S. Geological Survey's global deployment of so-called Seismic Research Observatory (SRO) seismograph stations. Besides using exceptionally sensitive broadband seismometers, these stations have digital recording systems where only real event data are stored via a triggering mechanism. The tapes from the various stations, including upgraded WWSSN stations, which are used for generating "stacked" tapes, (including all station recordings for specific events (for details, see *Engdahl et al.* [1982] and *Gunst and Hoff* [1982]).

Very recently, a consortium of U.S. academic research institutions has been formed with the explicit purpose of establishing a global seismograph network comprising roughly 100 broad band digital stations with suggested real-time satellite data transmission to one or more "world" data centers (*Incorporated Research Institutions for Seismology*, 1984].

Remote Seismic Terminal (Enhanced) Concept

Basically, the seismometry evolution described above has been motivated by theoretical advances and vice versa. An interesting aspect of this development is that strong research departments generally have become stronger, while most other grouping have become weaker. In the latter case the tendency is to turn inward, which in seismology often amounts in a tremendous emphasis on local earthquake activity monitoring with partly obsolete instrumentation. This situation is, of course, not unique for seismology, for many other branches of science are faced with similar problems, namely, that good research requires easy access to high quality data. Could this trend be remedied? Our answer is definitely yes, simply because in other parts of society work performance is becoming decorrelated from office location due to recent advances in microcomputer developments and telecommunications. We think that the RST and RSTE concepts (remote seismic terminal (enhanced)), to be presented below should overcome problems regarding data logistics with the goal of establishing whether or not multiple peaks are a persistent feature of the injection process. Our results support the conclusion that at least three-quarters of the ion enhancements that result in drift echoes are made up of multiple-peaked events. A very good correlation between the onset of the various peaks and detailed features observed in high latitude magnetograms is also observed, leading to the pairing of peaked events. In fact, in their relation to the magnetograms, there seems to be a pairing of pulses, that is, with each dip in the magnetogram there appears to be two associated ion pulses. Various possible models for the ion bearing multiple peaks, including the ion bearing magnetic field in the plasma sheet, magnetic instability in the plasma sheet, and/or, mirroring effects, temporal and/or positional effects of multiple neutral line formation, and effects due to different ion species are discussed.

RST and RSTE Prototypes

At the present stage of development, prototypes of RST and RSTE have been used in experiments thereby clearly demonstrating the viability of these concepts vis-à-vis the traditional seismometry ones. Below, we will give the necessary details on RST/RSTE developments in Norway, while in the next section a practical experiment will be described with simulated RST and RSTE operations in different countries.

Hardware

Both the RSTE and RST prototypes are based on a Z80A-based microcomputer from Northstar. The differences in hardware configuration are quite clear from Figure 1. The choice of Northstar was quite circumstantial; it just happened to be the one around at the time. The Z80A is an 8-bit microprocessor, and its processing capacity is quite adequate for our purpose at present.

Software

For the time being, the RST and RSTE prototypes have the same software. It is, of course, impossible to perform all the RST functions on the RSTE, and vice versa, but a great number of functions are available in both. The programs are all written by using FORTH programing systems [*Whitney and Conrad*, 1983]. The time critical routines are coded by using the built-in structured assembler.

The software system consists of a real-time scheduler, real-time and background tasks. The multitasking capability is very important, because this enables simultaneous data collection, analysis, and communication. An illustrative example here is that an RST may answer a call from a remote RSTE or another RST while an analyst is using the same system for data processing, or that an RSTE may continue sampling its seismometers while filtering, verifying, and transmitting data. It also allows for built-in "watch dog" functions in the unattended RSTE (e.g., restarting the system in case of an uncontrolled abort).

Present RSTE Functions

The following RSTE functions are now operative: (1) analog seismic data collection, A/D conversion, filtering, and real-time event detection processing; (2) event detection cataloging and relevant data storage; (3) demand and automatic digital seismic data transfer over the switched telephone network; (4) demand and automatic control of the conversion, filtering, and detection processes.

Other functions under consideration are weighted beam forming and detection log processing for providing a rough estimate of epicenter locations, including m_b magnitudes. It is here implicitly understood that the RSTE is handling a miniature seismometer deployment [e.g., see *Mykkeltveit et al.*, 1983].

Present RST Functions

As mentioned, our RST prototype is framed on a Northstar configuration, although the computer make is not critical here, since the RST is visualized as a rather permanent installation. Anyway, a major RST task is to serve as a terminal simulator for control and calibration of remote RSTE's. Associated RSTE functions available via modems are: (1) A/D converter gain and speed settings and channel selection; (2) filter parameter setting; (3) detection algorithm(s) and parameter selection; (4) directory display of detection log and stored events detection log (level 1 data); (5) transmission of selected event waveform data; (6) downloading new programs; and (7) exchange of data files stored on the RSTE's optional disk.

Other more generalized RST tasks are: (1) data base and receiving station for remote RSTE's; (2) data base and network node for the exchange of waveform files, bulletins, and messages; and (3) graphic work station for analyzing waveform data by using the graphic display, light pen, and plotter.

The latter task relates to interactive analyst operations, which so far has not been considered by us. However, U.S. scientists have developed a prototype of a work station which includes many advanced analysis routines aimed at significantly upgrading and standardizing analyst work (A. U. Kerr, DARPA, personal communication).

RST/RSTE Communication: The SAFT Protocol

Computer-to-computer linkage via switched telephone networks, data links, or satellites was established already in the early 1960's and is in widespread use today. An outstanding example here is the so-called ARPANET, which links together major computer centers in the United States and also with a line in Europe [NORSAR] [e.g., see *Kirstein*, 1975]. The protocols in common use here like HDLC, SDLC, DDCMP, etc., for handling the data transfers require special hardware and software at a substantial cost and therefore make themselves unsuitable for personal computer usage. A viable alternative here is the SAFT protocol (a simple ASCII file transfer system) specially designed for utilizing a standard RS 232 port, cheap modems, and dial-up telephone lines [*Fink et al.*, 1981].

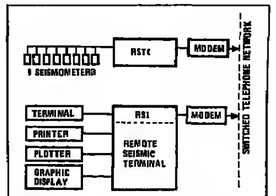

Fig. 1. Illustration of the RSTE/RST concept (remote seismic terminal (enhanced)). The RSTE is a specialized computer system without any moving parts. Its main tasks are to sample, control, and process its seismometers and originate and/or answer calls to/from RST's. The RST is the centrally located manned computer system with the necessary peripheral equipment and software for RST/RSTE communication, waveform display, etc. The only similarities between the RSTE and RST are the communication protocol (i.e., the RST could be any computer with an available RS232 asynchronous serial line).

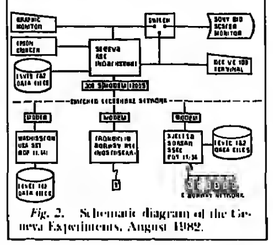

Fig. 2. Schematic diagram of the Geneva Experiments, August 1982.

Moreover, the SAFT software, available for most types of computers, appears to be implemented on very many academic research computers. In our RST/RSTE experiments, SAFT has been exclusively used for data transfers, and the only problems encountered have been tied to mismatch of modems. For example, the European standard modems differ from the U.S. standards, so special purpose ones have to be used for intercontinental data transfer. Finally, to be fair it must be stated that we do not believe that SAFT is the answer to all communication problems, but for transfer of modest amounts of data, messages, meetings abstracts, etc., it has some distinct advantages compared to the mentioned "network" protocols.

Geneva Experiment

The science of seismology is of political interest in the sense that underground nuclear explosions only can be detected by seismic means. Henceforth, to extend the present test ban treaty to comprise a ban on underground explosions, many countries insist on an adequate global seismological system for monitoring compliance with a future potential comprehensive test ban treaty (CTB). International disarmament negotiations in the United Nations' regi are largely delegated to the Conference of Disarmament (CD) whose member states regularly convene in Geneva. The political grouping has established an ad hoc group (not restricted to CD member states) for providing technical (seismological) advice on a monitoring system for underground nuclear tests. Last year, the ad hoc group's Norwegian delegation decided to demonstrate in practice the RST and RSTE concepts during its August session. These experiments, schematically depicted in Figure 2, will now be described.

Goal

Demonstrate RST operations from the top-floor restaurant in the U.N. headquarters in Geneva for an attendance of some 100 persons (political and scientific experts). The demonstration was to constitute the major part of an official Norwegian reception (cocktail party) at the restaurant.

Preparations

The RST and RSTE functions described previously were rigorously tested out in between NORSAR (near Oslo), DARPA (Washington), and E. Thoresen's study in his home in Trondheim, using the Northstar, NORSAR's PDP11/34-RSX11M, and DARPA's PDP11/44-UNIX.

Geneva Installations

The RST equipment—Northstar, terminal, printer, graphic display screen, plus modems—was shipped by air to Geneva and installed temporarily in the Norwegian mission. A locally rented video display screen of 1.8 m was included in the extended testing. The only surprise encountered was that the telephone tinning beeps were so strong that the 1200 baud modems occasionally missed commands with the consequence of garbled information. This had no consequences for the data transfers, since the SAFT protocol lean-

Article (cont. on p. 442)

Chapman Conference on Vertical Crustal Motion: Measurement and Modeling

A Chapman Conference on Vertical Crustal Motion: Measurement and Modeling will be held October 22—26, 1984, in Harpers Ferry, West Virginia.

Convenor: William E. Strange

This conference will bring together scientists who measure vertical crustal motions and those who analyze and model these motions with the primary objective of obtaining close interaction between the two groups. Emphasis will be on vertical crustal movement in North America. Questions to be addressed will be (1) what are the accuracies and error sources associated with each data type? (2) What is the extent of the current data base? (3) How accurately do we know vertical crustal motions in North America? (4) What are realistic expectations of contributions from space systems and other new technologies in the next decade? (5) What is the current status of modeling vertical crustal motions? (6) How important is vertical motion information to understanding and modeling earth dynamics? (7) What are the measurement requirements to support modeling and analysis in terms of temporal and spatial density and accuracy? (8) What are the most critical deficiencies of vertical motion data relative to modeling and analysis?

There will be invited and contributed presentations. The Call for Papers was published in the March 20, 1984, issue of Eos. Abstract deadline is August 1, 1984. Abstracts should be submitted to the American Geophysical Union.

For information on the required abstract format or further meeting logistics, contact:

AGU Meeting Department
2000 Florida Avenue, N.W.
Washington, DC 20009
(202) 462-6903

For program information contact:
Dr. W. E. Strange
NOAA/NOS/CNGS/NGS/N/CG11
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(301) 443-2520

Article *(cont. from p. 111)*

dles transmission of data messages automatically.

The Actual Experiment

The RST installation in the U.N. restaurant was uneventful and took only 30 min. The actual experiments in three steps were preceded by a brief talk on whys and hows. Also, the video screen proved very useful for large audience display of terminal operations.

Step 1. RST to RST communication. Automatic dialing and log in on a PDP11/44 running UNIX in Washington, D.C., over the ordinary telephone network using Bell 212 modems. Transfer of wave form data (level II data) and bulletins (level I data) from Washington to Geneva. In Geneva, we immediately displayed the analog waveforms on the raster scan graphic display screen and the video screen.

Step 2. RST to RSTE communication. This involved dialing and log in a an PDP11/34 at NORSA,. Kjeller, Norway. From the PDP11/34, we extracted real-time information on the status of the seismic network in southern Norway, including the detection log, which in turn was used to select a few, presumed particular events for display and analysis on the mentioned screens. Also, waveform data from the NORSAR library were extracted and displayed.

Step 3. This involved calling the Northstar "sister" RSTE in Trondheim. After establishing the modem link, we were able to demonstrate the RSTE functions described in the previous section. To generate some events, we started sampling with a rather low threshold and, behold, E. Thoresen's wife slammed a door at the appropriate moment creating the most spectacular event. This was immediately transferred to the RST in Geneva, and 10 s afterward it was displayed on the video screen.

Ad Hoc Demonstration

After the above experiments had been completed, a delegate from Australia asked us whether we could log in on his computer in Canberra. Given the telephone number and password, we could, on the first try, extract local bulletin files, etc. Further, the delegate drafted a message for his colleagues for proof of connection, which in turn was transferred to the Canberra computer. This ad hoc demonstration proved rather convincingly the feasibility of global data exchange.

An important aspect of the above experiments conducted from the U.N. building was that the RST hardware has a price tag of about $6000, while the Northstar microcomputer itself costs about $3000.

Future Prospects

The next step is to improve both RSTE and RST, particularly adding a more powerful CPU, an array processor for FFT matrix inversion, etc., and a few megabyte of memory to the RSTE. This will permit extensive data operations in the field and also allow distributed processing in the nodes of our network.

Additional field functions might include more filtering options, beam forming, spectral analysis, and rough event locations. The RSTE would then be able to generate automatic bulletins (level I data) and higher quality level II data. The net result will be less communication and thus more cost effective operations.

The RST development will be directed toward the expert-system concept. This means that an RST should administer several RSTE's and retrieve event data relevant for traditional analysis work and research. It should also have the option to retrieve bulletin files and level I data from foreign data centers, information that would be very helpful in local bulletin work. With such a data base hinted at above, combined with advanced analysis routines, interactive analysis, and wave parameter extraction should function expertly. Most important, individual seismologists, particularly those with a knack for microprocessor technology, should be able to participate actively in these developments, even from their studies at home.

Acknowledgments

We are much indebted to the Royal Norwegian Ministry of Foreign Affairs for research grants which made this work possible. Special thanks go to Ambassador Sten Lundbo, Norwegian Mission, Geneva, for support and encouragement and to A. U. Kerr (DARPA) for invaluable conceptional advice. NORSAR contribution 335.

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News

Venus Mapper Resolution

NASA program managers for the Venus Radar Mapper (VRM) mission have decided to make improvements to the spacecraft's Synthetic Aperture Radar (SAR) system that will increase its mapping resolution by one and a half times over the original design. The changes, including a doubling of the system's range bandwidth, will add a total of about $3 million to a project budgeted at $350 million. VRM is scheduled for launch toward Venus in April 1988 and will map more than 90% of the cloud-veiled planet's surface during its 8-month mission.

The decision by the VRM program office at NASA headquarters in Washington was based on recommendations from the mission's project office at the Jet Propulsion Laboratory in Pasadena, Calif. When VRM was included as a new start in this year's NASA budget, the stated goals for the mission were to provide a near-global map of Venus at resolutions better than 1 km, or roughly equivalent to the resolution of the Mariner 9 mission that first revealed the geological richness of the Martian surface. The initial best radar resolution was to have been about 180 m (equivalent to an optical line-pair resolution of 300 m) attainable for more than half the surface of the planet. VRM will travel an elliptical orbit and so will only be able to map the surface for a fraction of each day. The highest resolutions will come in the equatorial region when the spacecraft is closest to periapsis and the radar "look angles" are the greatest.

Now, with the improvements to the SAR system, the resolution will range from 120 m (again for more than half the surface) to about 190 m in the higher Venus latitudes. This is nearly an order of magnitude better than what the Soviets have obtained with their Venera 15 and 16 orbiters now circling their mapping missions around Venus. Those spacecraft are mapping between 25 and 33% of the planet, primarily around the north polar region, at resolutions ranging between 1 and 2 km. While the Venera images have proven very interesting to the few American scientists who have had access to them (the Soviets still have not released the pictures publicly), VRM promises much sharper images and more complete coverage.

It was the Venera results, in fact, that provided the impetus to make the improvements to VRM's radar system. "When our (VRM team) scientists looked at the Soviet images and began seeing all the interesting topography, they began to see how much more detail they wanted," says VRM Program Manager Rodney Mills. "We decided we wanted to squeeze out as much resolution as we possibly could." Gordon Pettengill of the Massachusetts Institute of Technology, the radar instrument's Principal Investigator, says that at resolutions close to 100 m, scientists should be able to detect all the processes that might shape the Venusian surface with the exception of wind erosion. The clarity of the VRM images will be particularly helpful in dating the relative ages of overlapping lava flows on the surface.

According to Mills, the improvements to the radar system will affect range resolution, but won't significantly affect the azimuth resolution of the images. The SAR instrument, built by Hughes Aircraft, is the only science instrument on the VRM spacecraft, which is being built by Martin Marietta. The radar is similar to the ones that have been flown successfully on the Seasat mission and the Shuttle Imaging Radar-A (SIR-A) experiment that flew onboard *Columbia* during the second flight of the space shuttle. It operates on the principle that changes in doppler shift of a reflected signal can be combined with range data to construct two-dimensional images of a planet's surface that resemble photographs. Because Venus is perpetually enshrouded by clouds, radar is the only means to image its surface.

Venus Radar Mapper will also soon have a new name. NASA officials have been whittling away at a list of candidate names that include some historical figures (along the line of Galileo and Giotto) and some more traditional spacecraft names (along the line of Voyager and Pioneer). VRM is expected to shed its acronym and be "re-christened" sometime before the end of July.—*TR*

Anne Burford to NACOA

Anne Burford, who resigned as administrator of the U.S. Environmental Protection Agency (EPA) in March 1983, has been appointed chairman of the National Advisory Committee on Oceans and Atmosphere (NACOA). Seven others have been appointed to the 18-member committee, which advises the president on ocean and atmosphere policy.

Burford succeeds John A. Knauss as NACOA chairman. Knauss, whose term of office on NACOA officially expired on July 1, had been on the committee for 6 years. Burford resigned from EPA following controversy over hazardous wastes.

In his proposed budget for fiscal 1985, as in recent years, President Ronald Reagan eliminated NACOA. In previous years, Congress has reinstated the committee. Bills (S. 1098 and S. 2538) to reinstate NACOA for fiscal 1985, which begins October 1, have been introduced and have been hotly debated in Congress. A conference between members of the House of Representatives and the Senate to discuss NACOA's future—including reconstituting the committee in a different form—will be held probably between July 23 and August 10.

Also appointed to NACOA are John E. Bennett, a retired Navy captain from Solana Beach, Calif. His term expires in 2 years. William Brewster, vice president and director of the Atlantic Salmon Foundation and chairman of the executive committee of the International Atlantic Salmon Foundation, will serve until July 1985. Lee Gerhard, Getty Professor of Geology at the Colorado School of Mines, has been appointed until July 1986. Judith Kildow, appointed through July 1986, is an associate professor of ocean policy at the Massachusetts Institute of Technology. Mary Ellen McCaffree, appointed through July 1985, is former administrative assistant to Sen. Slade Gorton of Washington and former director of the department of budget and program development for King County, Wash. Nathan Sonenshein, whose term expires in 1986, is assistant to the president of Global Marine Development, Inc., of Newport Beach, Calif. Gordon Snow, appointed through 1985, is assistant secretary for resources of the California Resources Agency in Sacramento, Calif.

The next NACOA meeting is August 2 and 3 in Washington, D.C. NACOA meets eight times per year. Steven N. Anastasion is the executive director.—*HTR*

Water in Cirrus Clouds

Meteorologists from the University of Utah have discovered water droplets as cold as −56°C at the base of cirrus clouds, the coldest temperatures at which liquid water has been confirmed in clouds. Because earlier models of radiation transfer in the atmosphere had assumed that the clouds at cirrus-layer altitudes (6,000–12,000 m) were composed only of ice crystals, the presence of liquid water may affect how these models are constructed.

A team led by Kenneth Sassen at Utah's Department of Meteorology used ground-based polarization laser radar (lidar) to detect the water droplets in a cirrus cloud layer approximately 8.2 km above Boulder, Colo., last October. By analyzing the polarization of laser light reflected from cloud particles, the lidar system can identify whether the cloud contains water or ice crystals and can provide information on the type and distribution of ice crystals within the cloud.

The lidar results were supported by data from an instrumented aircraft of the National Center for Atmospheric Research (NCAR) in Boulder, which flew through the 1.9-km-thick cirrus cloud near its base, measuring the sizes and concentrations of crystals and droplets. The combined lidar and aircraft data showed that liquid water droplets occurred in a narrow layer at the bottom of the cloud, with a density of up to 130 drops per cubic centimeter and temperatures as low as −53° to −36°C. Within 100 yards above the base of the cloud, the water appeared to freeze rapidly into ice crystals.

The supercold liquid droplets, according to Sassen, probably are short-lived, lasting "only a matter of minutes" before freezing. At temperatures below −40°C, he said, water is believed to freeze spontaneously. These droplets, however, take some time before they turn to ice. A possible explanation is that there is a relative scarcity of dust particles and other condensation nuclei at the high cirrus altitudes, so that it takes longer for the ice crystal to form than it does at lower altitudes.

Cirrus clouds have been shown to play a part in the transfer of solar and terrestrial radiation through the atmosphere, and this radiation budget in turn has a great affect on global climate and the atmospheric greenhouse affect. Climate modelers have assumed up until now that cirrus clouds were made entirely of ice crystals and have used approximations of the hexagonal shape of these crystals in their computer models to predict how radiation will be scattered. Water droplets are spherical, though, and they scatter radiation differently than hexagonal crystals. If the water layer is a permanent feature at the base of cirrus clouds, even if the layer is only 100 m thick, it would mean a change in the radiation transfer models. The next step, according to Sassen, is to continue lidar investigations of other cirrus clouds to see if this water layer occurs elsewhere and if the base of the clouds remains watery over a long period of time.

Congressional Capsule

Several geophysics-related bills were passed as the House of Representatives and the Senate each scrambled to complete as much business as possible before the recess for the Independence Day holiday and the Democratic National Convention. The House and Senate will reconvene July 23.

The Senate ratified the compromise version of the Land Remote-Sensing Commercialization Act (H.R. 515[5] (*Eos*, July 3, 1984, p. 425) in the final hours before recessing. The bill was expected to be sent to President Ronald Reagan for his signature as *Eos* went to press.

In addition, the House passed H.J.Res. 553, which designates July 20, 1984, as Space Exploration Day, in commemoration of the 15th anniversary of the Apollo 11 moon landing. The House also passed S.J.Res. 237, which designates the year that began July 1, 1984, as the Year of the Ocean (*Eos*, June 19, 1984, p. 402). The Senate had passed the measure on June 8.

The House approved a version of H.R. 3282 reauthorizing and amending the Clean Water Act. Although the Senate Environment and Public Works Committee reported out the Senate version of the bill 9 months ago, the entire Senate has not voted on the bill.

The House passed the Water Resources Authorization (H.R. 3678) by a 229 to 38 margin on June 23. There is no companion bill in the Senate. The bill details steps for the "construction and development of water and related resources and the improvement and rehabilitation of the nation's water resources infrastructure." Much of the bill deals with regulating beach erosion, floods, drinking water supplies, and channel navigation, construction, and engineering by the U.S. Army Corps of Engineers.—*BTR*

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Cover. Prince Patrick Island, Northwest Territories, Canada, is the land in the photograph. Mould Bay is beyond the foreland, and the weather observing station of the same name is located up this fiord, but off the photograph to the right. The date was July 2, 1982, during the FIREX/RADARSAT field experiment. The altitude of the aircraft was nearly 250 m. The open fault is from near-shore southeasterly to Crozier Channel. Open faults such as this were common in the first-year ice of the region. They caused prominent "bright" features in the radar imagery. They formed in June when solar heating had raised the temperature of the ice to within a few degrees of 0°C. In Mould Bay the spacing between faults varied from 2 to 4 km and had openings, initially, of at most a few meters. The faults were normal to the long axis of the bay, in strike, but were single, echelon, or bifurcated openings. Hinged blocks and a zigzag run were typical, similar to the fault in the photograph. The open faults in Crozier Channel appeared to be haphazardly scattered with random orientations but were located almost exclusively in first-year ice such as that shown in the photograph. Puddling on the ice from the melting of snow and ice was near maximum area for the season. It varied greatly from place to place. At the time of the photograph and for some days preceding, the prevailing wind was from left to right (i.e., a southwesterly). This has affected the dramatic asymmetric drainage pattern in the foreground of the photograph. Southwesterlies had also affected another feature, crescentric shapes, to the right of the open fault, which are remnants of barchan snow dunes. Deeper snow cover retards melting of the underlying ice and causes the localization of ponds where the snow depth is thin or nil. Most of the icy "highground" photograph was due to deeper snow cover; some of it was due to ice deformation during freezeup. (This photo was contributed by Arnold M. Hanzlik, research scientist, Department of Atmospheric Sciences, University of Washington, Seattle, WA 98195.)

BOSP Solicits Community Input

To fulfill its role in serving the ocean sciences community and the federal agencies that fund ocean activities, the Board of Ocean Science and Policy (BOSP) of the National Research Council is calling for community input to a report on future trends and new opportunities in ocean science and policy through the year 2000.

BOSP is seeking information on the needs and opportunities in the field as broadly defined as ranging from augmentation of existing activities to new facilities to new ideas. In its first stage, the study will consist of a series of reports focused on 10 areas (see list below). The second stage will focus on themes that link the defined disciplines. Ideas and suggestions about linking themes also are welcomed for the BOSP report.

The areas of study and the scientists assembling information on them are listed below.

- Oceans 2000: Brian J. Rothschild (University of Maryland, Solomons) and John H. Steele (Woods Hole Oceanographic Institution)
- Physics: D. James Baker, Jr. (Joint Oceanographic Institutions, Inc.)
- Geology and geophysics: Charles L. Drake (Dartmouth College)
- Waste disposal: Edward Goldberg (Scripps Institution of Oceanography)
- Minerals: G. Ross Heath (Oregon State University)
- Policy science and law: Judith T. Kildow (Massachusetts Institute of Technology)
- Biology: James J. McCarthy (Harvard University)
- Weather and climate: Roger Revelle (University of California, San Diego)
- Chemistry: Karl K. Turekian (Yale University)
- Economics and business: Robert M. Solow (MIT).

These reports, being prepared now, will be discussed at a meeting of BOSP in August. Before then, relevant information should be sent to the appropriate person or to Nancy Maynard, Executive Secretary, Board on Ocean Science and Policy, 2101 Constitution Avenue, Washington, DC 20418 (telephone: 202-334-2714).

TRAVEL GRANTS TO IASPEI REGIONAL ASSEMBLY HYDERABAD, INDIA

Deadline for Applications August 31, 1984

AGU has applied for grant funds to assist the travel of individual U.S. scientists to the IASPEI Regional Assembly to be held in Hyderabad, India, October 31—November 7, 1984. In anticipation of receipt of this funding, application forms for individual grants are available from:

American Geophysical Union
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Washington, D.C. 20009
(Telephone: 462-6903
or toll free: 800/424-2488
outside the Washington D.C. area)

Geophysicists

Bruce A. Bolt, professor of seismology and director of the seismograph stations at the University of California, Berkeley, assumed the chairmanship last month of the California Seismic Safety Commission. Established by the state legislature in 1975 after the 1971 San Fernando earthquake, the commission advises the governor, state legislature, and local governments on all aspects of California seismic safety policy.

Yves Desaubies, currently associate scientist at the Woods Hole Oceanographic Institution, is joining the Centre Oceanologique de Bretagne in Brest, France. He will be in charge of the Ocean Acoustic Tomography program for the Centre National pour l'Exploitation des Oceans (CNEXO).

Books

Proceedings of the Seventh Symposium on Antarctic Meteorites

T. Nagata (ed.). *Mem. of Nat. Inst. of Polar Res.*, vol. 25, National Institute of Polar Research, Tokyo, iv + 348 pp., 1982.

Reviewed by Martin Prinz

Since the Japanese Antarctic Research Expeditions (JARE) of the National Institute of Polar Research (NIPR) in Tokyo began finding abundant meteorites in 1969, they have established a highly impressive record of developing the science of meteoritics in Japan on a broad international scale. As a part of this effort they have held annual symposia in Tokyo, involving mainly Japanese scientists, some already well established in other areas, and an impressive array of younger ones. Some scientists from the United States and other countries also attend. The seventh symposium was held on February 19 and 20, 1982, at the NIPR.

Before reviewing the proceedings volume, a few words should be said about the meteoritic milieu in which the conference is set. From a country involved only in a minor way with meteoritic research 15 years ago, Japan has emerged as a major force on the scene, bringing forth new investigators as well as a stream of new meteorites. Much of this accomplishment is due to Takesi Nagata, director of the NIPR, organizer of the symposia and editor of the volumes. He is helped by an able staff, both scientific and editorial, in producing the volumes, each of which increases in quality, breadth, and size as the years proceed.

At the seventh symposium, 47 papers were presented, and the proceedings volume contains 25 papers that may be classified into four groups: two on classification, eight on mineralogy and petrology, four on trace element and isotopic geochemistry, and four on physical properties.

Miura and Matsumoto classified six new Antarctic chondrites and were concerned with determining those that were paired. Mason and Clarke characterized and classified 100 new meteorite specimens. They also carry out this valuable work for the U.S. Antarctic program.

Ikeda studied a C3 chondrite containing various chondrite components, whereas Nagahara and Kushiro studied similar components in a CO3 chondrite. Clarke and Mason described a new mesosiderite with some unusual aspects, and Nagahara studied FeNi metal in four different provenances in type 3 ordinary chondrites to determine their cooling rates and implications for the parent body history. Takeda and Yanai examined Yamato 1979 achondrites, including eight polymict eucrites, a howardite, and a urelite. Polymict eucrites help in understanding the nature of the basaltic parent body, which is surely more complex than envisioned before the new Antarctic meteorites were found. The *urelite* parent body is also more complex than earlier believed, as evidenced by the Antarctic urelite described which contains a three-pyroxene assemblage and augites and an anglite.

Meteorites in ordinary chondrites was examined by Miura and Matsumoto and found to differ somewhat from those in urelite. Akai studied five types of phyllosilicates in the matrix of a carbonaceous chondrite and suggested that it contains a new 11 Å mineral with an interstratified structure of serpentine-like and brucite-like layers.

Shimizu and Masuda found Ce anomalies and Yb-Lu deviations in the REE of Antarctic eucrites, but not in the non-Antarctic ones. These deviations were not found in other Antarctic meteorites, and they discuss the implications for pre- and post-terrestrial processes producing these effects. Takaoka studied the noble gases and isotopic compositions of He, Ne, and Ar in Yamato chondrites, and Yagi and coworkers studied Muong Nong tektites.

Isotopically, Nishimura and Okano found excess ^{26}Mg in a Yamato L3 chondrite, using an ion microprobe mass analyzer. Komura and coworkers concentrated on ^{26}Al in Yamato meteorites, for which data of this type are scarce. They also note that Antarctic meteorites are highly contaminated with ^{137}Cs derived from nuclear test explosions.

McFadden and coworkers made spectral reflectance measurements on three Antarctic diogenites and observed measurable differences when all diogenite spectra were compared. They found bands due to spin-forbidden transitions of Fe^{2+} ions in pyroxenes for the first time. Fujimura and coworkers looked for preferred orientation of phyllosilicates in two Yamato C2 chondrites to relate it to degree of reformation.

Nagata studied 16 iron meteorites and magnetically classified them into three groups. Nagata and Funaki were particularly concerned with retrameteite-rich stony meteorites and note that owing to its presence the NRM contains a highly stable component with large magnetic and optical anisotropy. They also studied the possible effects of mechanical stresses upon the magnetic properties of stony meteorites, the piezoremanent magnetization (PRM).

Sugiura and Strangway studied the magnetic properties of type 3 and 4 ordinary and enstatite chondrites and found complex results with regard to the intensities of the magnetic field at different temperatures and discuss whether these are pre- or post-accretional events. Hamano and Yomogida studied magnetic susceptibility anisotropy and porosity in ordinary chondrites and found that

Books *(cont. on p. 444)*

Books *(cont. from p. 443)*

compressive during the accumulation stage of chondritic parent bodies was the main cause of the anisotropy.

Miyamoto and coworkers attempted to reduce the effects of black material from the special reflectance of meteorites on asteroids by some ingenious methods. Their results can be helpful in making more realistic paintings of meteorites and asteroids. The physical properties of some unequilibrated ordinary chondrites were measured by Yomogida and Matsui. They find a rough trend whereby porosity decreases with increasing petrologic grade for H chondrites, but they cannot see it for L chondrites. Fujii and coworkers studied the shape of FeNi grains in H and L ordinary chondrites and find that the average shape parameter appears to decrease with increasing petrologic grade from 4 to 6. Miyamoto and coworkers studied the fracture strength of various stony meteorites and suggest that LR chondrites were larger than other petrologic types of L chondrites in space.

Clearly, the results of the mainly Japanese contributions to this volume are impressive. The volume contains abundant tables and figures, and the typesetting is clear. Typographical errors are not too common, and the English, while sometimes awkward, is generally very good.

Martin Prinz is chairman of the Department of Mineral Sciences, American Museum of Natural History, New York.

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POSITIONS AVAILABLE

Postdoctoral Position/University of Arizona. A postdoctoral position has been opened at the Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona, in July 1984. The research is in the general area of space and planetary physics with much of the work related to Voyager EUV observations at the outer planet encounters. The program includes work in plasma physics concerned mainly with the fundamental nature of the ionized plasma torus, with the ionospheric and auroral processes on Jupiter, Saturn, Titan, Uranus and Neptune, exosphere-magnetosphere modelling at Saturn, and some specialized aspects of the interstellar-interplanetary medium. The applicant should have a background in atomic and molecular physics with an interest in planetary atmospheres. Applications should consist of a statement of interests, and names of three references, and should be submitted by August 30, 1984. Further information can be obtained by contacting D. E. Shemansky, Lunar and Planetary Laboratory, 3925 E. Ajo Way, Tucson, Arizona 85713; 602-621-2904.

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Geochemistry Instrumentation Technician. The Department of Geological Sciences seeks a full-time staff technician to be in charge of its analytical facilities. Major equipment includes X-ray fluorescence and diffraction, atomic absorption, plasma emission, and neutron activation. Duties include equipment maintenance, shared responsibility for calibration and quality control, and systems development. Responsibilities also include supervision of and involvement in sample preparation, analysis of geologic samples, and data reduction. The applicant must have demonstrable laboratory/mechanical skills; abilities in electronics troubleshooting and utility computer programming are desirable.

A background in chemistry or geochemistry is desirable. Opportunity of individual research exists and is encouraged. Salary ($19,872) and utilization level of integration into departmental research programs dependent on candidate's abilities, interest and professional growth. Send resume and two reference letters to:

Dr. G.R. Keller, Chairman
Department of Geological Sciences
University of Texas at El Paso
El Paso, Texas 79968-0555

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Marine Research Associate #V. Applications are invited for a two-year, state-supported postdoctoral fellowship in marine geophysics at the Graduate School of Oceanography of the University of Rhode Island for the period of October 1, 1984 to September 30, 1986. The marine geophysics group has special interests in arrebuary plate boundary structures and processes, but we also encourage interests from workers in continental margin structure, satellite geophysics, theoretical geophysics, or other fields related to the marine aspects of geophysical research. Salary range $24,131 to $30,714 depending on qualifications and experience. Ph.D. in marine geophysics or an allied field is required. Send resume and name and addresses of three references by July 31, 1984 to: Roger L. Larson, Marine Research Associate IV Position, Graduate School of Oceanography, The University of Rhode Island, P.O. Box 357, Kingston, Rhode Island 02881–0357.

An AA/EOE, m/f.

Postdoctoral Fellow in Atmospheric Science. A position will be available beginning October 1, 1984, at the Harvard-Smithsonian Center for Astrophysics for theoretical analysis of the Shuttle glow and studies of upper atmosphere physics and chemistry. A Ph.D., which involved research in astronomy, is required. Send applications and names of three references to: A. Dalgarno, Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138.

Physical Oceanographers. The Marine Life Research Group of the Scripps Institution of Oceanography invites physical oceanographers to apply for a research position. The research equivalent of the professional series Ph.D or equivalent is required, to study the circulation of the California current and eastern north pacific. support is offered for two years. After which the candidate may be expected to generate all or part of continuing support.

Salary range $25,100—41,800. Level of appointment to be based on qualifications. Position start date from 1 September 1984.

Please civil resume and at least three references to Dr. Oscar Sette, Marine Life Research Group, A-030, Scripps Institution of Oceanography, La Jolla, California 92093 by August 1, 1984.

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University of Texas at Austin. The Department of Geological Sciences invites applications for a person to teach depositional systems and petroleum geology at the undergraduate and graduate levels and to conduct a vigorous research program, including the supervision of graduate students, in the area of the person's interest. The person must be willing to teach the above subjects to non-majors on occasion. The position requires the Ph.D. and is open to both tenure-seeking junior persons and senior level persons. Availability by January 1985 is desirable. Applicants should submit a detailed resume, names and addresses of three references, and a statement of teaching and research interests by November 1, 1984 to Dr. Earle F. McBride, Department of Geological Sciences, University of Texas, Austin, Texas 78712. New Ph.D.-holders should also submit a copy of their dissertation abstract.

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Faculty Position in Atmospheric Sciences/North Carolina State University. A tenure track nine-month position is available at the Assistant/starting Associate Professor level beginning January 1985. The appointee must have completed all requirements for the Ph.D. degree and should have a strong background in dynamical meteorology. Specialization in mesoscale phenomena and pro-research emphasize mesoscale phenomena and processes. An opportunity exists to participate in the recently initiated GALE program. The appointee will be expected to teach courses at both the undergraduate and graduate levels. The appointee would join the Marine, Earth and Atmospheric Sciences Department, which consist of 8 meteorologists, 11 geologists and 11 marine science faculty. The Department enjoys well-established and mutually-beneficial relationships with the related programs at the University of North Carolina at Chapel Hill, Duke University and institutions in the nearby Research Triangle Park. Applicants should submit a resume, and the names and addresses of three references to Dr. S.P.S. Arya, Chairman, Search Committee, Department of Marine, Earth and Atmospheric Sciences, North Carolina State University, Box 8208, Raleigh, NC 27695–8208; 919-737-2210. Committee action of applicants will begin on September 1, 1984. North Carolina State University is an Affirmative Action/Equal Opportunity Employer.

Project Associate/Specialist Electron Micro-Probe Lab, University of Wisconsin-Madison. Strong analytical background in quantitative EMP analysis and familiarity with computers is required. The Lab has a 9-spectrometer ARL SEMQ and a JEOL-CO 50-A SEM. Duties will include instrument maintenance, instruction of students, development of procedures and analysis. Research will be encouraged. A MS or PhD is required in Earth Science, Chemistry, Physics or Engineering. Minimum salary will be $18,000/12 months with an MS. Send letter of application, transcripts, resume, and names and addresses of three references by September 15 to Dr. John W. Valley, Department of Geology & Geophysics, Weeks Hall, University of Wisconsin, Madison, WI 53706.

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Postdoctoral Research Associate Position/Geophysics and Igneous Geochemistry. The University of Maine at Orono (UMO) has postdoctoral openings for a solid earth geophysicist and an igneous geochemist. We seek a geophysicist who wishes to advance fundamental understanding of past and current thermal histories of the Appalachian Orogen in New England and elsewhere. The geochemist would be expected to investigate volcanic and plutonic suites in the Appalachians in Maine and in other terranes. Current funding permits appointment for at least 12 months. Subject to arrival of anticipated funding, the appointments could be extended to two years. Both appointments could start as early as August 1, 1984. Excellent facilities for geothermal research, computer applications, petrologic research and geochronologic studies exist at UMO. Additionally, limited funds are available for travel and research, and the appointees will be encouraged to generate external support individually or through cooperation with existing faculty. Please send inquiries, a vita, a list of referees, and a description of research interests to Edward R. Decker or Daniel R. Lux, Department of Geological Sciences, 110 Boardman Hall, University of Maine at Orono, Orono, Maine 04469. Telephone calls may be made to 207-581-2122, and forwarded to Decker or Lux.

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Research Associate/Research Technician. The University of Maine at Orono (UMO) has an opening for a research associate/research technician who would work in a small geophysical group. We seek an individual who can use and maintain modern digital electronic equipment; for example, multichannel analyzers, I/O interfaces for microcomputers, digital plotters and digitizing tablets. Familiarity with BASIC and FORTRAN will be needed, and some geophysical field work may be required as part of the duties of the appointee. Current funding permits an appointment for at least 12 months. Subject to arrival of anticipated funding, the appointment period could be extended in two years, or longer. Call Edward R. Decker at 207-581-2168 or 207-581-2152 to learn about the position. Otherwise, send inquiries, a vita and a list of at least three references to Edward R. Decker, Department of Geological Sciences, 110 Boardman Hall, University of Maine at Orono, Orono, ME 04469.

The University of Maine is an equal opportunity/affirmative action employer.

Ocean Engineering Research/University of California, San Diego. The Institute of Marine Resources at the Scripps Institution of Oceanography, University of California, San Diego has three openings for assistant/associate research engineers or assistant/associate professors to participate in the development of ocean engineering programs. Candidates should have a Ph.D. or equivalent in engineering, physics or oceanography, a publication record and should have interest in taking part in research in one or more of the following fields: 1) deep ocean waves, remote and in situ measurement and analyses of directional spectra, and wave/structure interactions, 2) floating and fixed platforms, response to waves, structural analysis, corrosion and fatigue, 3) ocean floor geotechnical studies, initiation of mass movements, scour and soft bottom anchors. The salary range is $25,100-$35,800, depending upon qualifications. Appointment duration two years with possibility of indefinite extension. Appointment as professor is subject to the availability of an appropriate tenure line. Appointment at the associate level requires a record of successful funded research. Associate professor rank requires teaching experience. Send resume and names of references before 1 September, 1984 to: P. N. Spies, Director, Institute of Marine Resources, or R. J. Seymour, Head Ocean Engineering Research Group, Institute of Marine Resources, at Scripps Institution of Oceanography, La Jolla, CA 92093.

An equal opportunity, affirmative action employer.

Instructor. We anticipate hiring a one-year temporary instructor beginning September, 1984. Ph.D. degree preferred. The position might evolve into a tenure track position. Must be able to teach a year course sequence (2 semesters) of undergraduate level mineralogy-petrology (including hand samples, optical mineralogy, and petrography), and at least one or two courses in Mineral Resources and Ore Deposits. Participation in one or more introductory courses may be required. In addition, the successful applicant will be expected to contribute to both our undergraduate and M.S. programs through participation in seminars, field trips and student projects. Submit letter of application and resume by August 17, 1984 to: O. Don Hermes, Acting Chairman, Department of Geology, THE UNIVERSITY OF RHODE ISLAND, Kingston, RI 02881–0807.

An AA/EOE, m/f.

University of Denver/Postdoctoral Research Physicist. The Department of Physics at the University of Denver invites applications for the position of Postdoctoral Research Physicist. Successful applicant will operate several infrared instruments to obtain atmospheric spectra under various conditions; will be responsible for interpretation of the spectra obtained based upon a knowledge of molecular spectroscopy. Analysis requires use of large digital computer (FORTRAN).

QUALIFICATIONS: Must have a Ph.D. in Physics, or possibly Meteorology or Chemical Physics.

SALARY: Range of $23,000 to $25,000 depending upon qualifications and experience.

Interested applicants should write to Professor R.G. Annino, Chairman, Department of Physics, University of Denver, Denver, CO 80208. All inquiries will be answered. Initial inquiries should include a resume of the applicant's applicable background, experience, professional interests, and names of at least three references.

The University of Denver is an equal opportunity/affirmative action employer.

Environmental Science and Engineering, Inc. ESE, an international environmental consulting company, has an immediate need for the following individuals:

Water Resources Modeller: Responsibilities to include the application of ground and surface water flow and water quality models, maintenance of the water resources model library, conducting statistical data analysis, and the preparation of technical reports on modeling studies. Position requires an MS in engineering or applied science, two to five years related experience with IBM and Prime Systems and excellent writing and communication skills. Experience with SAS or SPSS Statistical Packages desired.

Water Quality Scientist: Responsibilities to include the interpretation of water quality data, including ground water data; contaminant transport studies and behavior characterization of toxics chemicals in shallow ground water and surface water systems; and the preparation of technical reports. Position requires MS in environmental or geochemistry and excellent writing and communication skills.

Ground Water Hydrologists: Responsibilities to include the management of hazardous waste investigations, ground water monitoring and contamination assessments, geophysicals studies, ground water supply development and permitting, landfill siting and land application of wastewater. Position requires MS in geology or environmental engineering and a minimum of three years experience; prior project management experience required.

Interested individuals should submit their resume with salary requirements to:

Environmental Science & Engineering, Inc.
Dept. FBST
P.O. Box ESE
Gainesville, FL 32602.

An Equal Opportunity Employer.

Science Writer. AGU is expanding the Eos staff and has an immediate opening for an experienced reporter/writer. Candidate must be able to research, interview, and write on news scientific research, trends, and/or results for readers. Will also prepare timely reports on the effects of government legislation on the science community and the general public. In addition, candidate will be expected to participate in AGU's developing public information activity. Salary $19,000—$24,000. Send resume with news writing samples to:

Personnel Office
American Geophysical Union
2000 Florida Avenue, N.W.
Washington, D.C. 20009.

Assistant In Research. The Department of Marine Science invites applications for a position as assistant in research. This is a 9-month 0.75 FTE position. A M.S. in either geology, geochemistry, analytical or inorganic chemistry, or physical chemistry is required.

The desired experience should include a strong background in geology and mineralogy with knowledge of X-ray techniques of identification. It would be helpful to have knowledge of foreign language, especially French and Russian. A knowledge of thermodynamics and electrochemistry with strong experience with a variety of analytical techniques and familiarity with hydrographic searches is also desired.

This is a grant position and will run to the termination of funding. Resume and the names of three references should be sent to:

Dr. Robert M. Garrels
University of South Florida
Department of Marine Science
140 7th Avenue South
St. Petersburg, Florida 33701.

The University of South Florida is an affirmative action/equal opportunity institution. Closing date for applications is July 31, 1984.

Electrical Engineers/Computer Professionals/Systems Analysts/Physicists/Mathematicians. Systems & Analytical Sciences, Inc., a young dynamic company, invites applications from BS/MS/PhD degree holders to fill many positions. Experience in Signal Processing, Hardware/software development, Communication Systems R&D, Systems Analysis, Numerical and Simulation studies, Remote Sensing, Meteorology, Space Sciences and related fields. U.S. Citizenship required but not a must. Excellent salaries and unparalled company paid benefits offered. Please send resume to: Mr. Charles Giffin, Director of Marketing, Systems & Analytical Sciences Inc., Hanscom Civil Air Terminal Building, Bedford, MA 01731.

SERVICES, SUPPLIES, COURSES, AND ANNOUNCEMENTS

Consultant. Specialist in resource exploration and development (mineral, petroleum, and groundwater-mining and petroleum engineering). Johns Hopkins PhD with extensive practical experience in the Middle East and elsewhere. Multilingual fluent in Persian and Turkish. Reply to Box 024, American Geophysical Union, 2000 Florida Avenue, N.W., Washington, D.C. 20009.

Meetings

Announcements

Numerical Methods

July 24–26, 1984 Numerical Methods in Science and Engineering, Ashurst, Southampton, England. Sponsor: The Computational Mechanics Center. (Course Department, Computational Mechanics Center, Ashurst Lodge, Ashurst, Southampton SO4 2AA, England.)

The objective of this short course is to provide the fundamental numerical skills required to solve problems commonly encountered in science and engineering. The skills will be developed from first principles so that the practitioner will be capable of either writing his own computer code or expanding and modifying existing codes.

Mining and Groundwater

August 27–29, 1984 Conference on the Impact of Mining on Groundwater. Denver, Colo. Sponsor: The National Water Well Association. (David Nielsen, National Water Well Association, 500 W. Wilson Bridge Rd., Worthington, OH 43085.)

Deadline for early registration is August 10, 1984.

This two and a half day conference includes sessions on legal and regulatory issues, the hydrologic impact of coal mining, groundwater modeling to assess the impact of mining, the impact of longwall mining on groundwater supply, the impact of coal mining on groundwater quality, impacts of uranium mining and tailings storage on groundwater, impact of lead-zinc mining on groundwater, and dewatering system design.

Sinkhole Conference

Oct. 15–17, 1984 First Multidisciplinary Conference on Sinkholes, Orlando, Fla. Sponsors: Florida Sinkhole Research Institute, Univ. of Central Florida. (Barry Beck, Director, Florida Sinkhole Research Institute, College of Engineering, Univ. of Central Florida, Orlando, FL 32816; tel.: 305-275-2043.)

The geology and engineering of sinkholes will be explored at this multi-disciplinary conference. Tentative session topics include causes of sinkholes; remote sensing and geophysical detection of sinkhole-prone areas; sinkholes in the hydrologic cycle; man-induced sinkholes; engineering construction in sinkhole-prone areas; repair and stabilization of sinkholes; and sinkholes and man: legal and societal problems.

Snow Cover

Oct. 17–19, 1984 CRREL/ARO Workshop on the Interaction of Radar with the Seasonal Snow Cover, Cold Regions Research and Engineering Laboratory, Hanover, N. H. Sponsors: CRREL, AGU Hydrology Section. (S. C. Colbeck, CRREL, 72 Lyme Rd., Hanover, NH 03755.)

The program will include five reviews of active radar measurements, passive radar measurements, dielectric properties of snow, snow property measurements, and snow physics. The major portion of the workshop will be devoted to open discussions on each of these topics. Short presentations will be possible during these discussion periods.

IGCP Project on Tethys Margin

Oct. 15–21, 1984 IGCP Project 198: Evolution of the Northern Margin of Tethys. Bratislava, Czechoslovakia. Sponsor: International Geological Correlation Program. (Alan Nairn, Earth Sciences and Resources Institute, Univ. of South Carolina, Columbia, SC 29208.)

The thematic working groups for the meeting will discuss sedimentation; lithofacies; paleogeography; faunal aspects; structural history; tensional phase; compressional phase; igneous activity; and geophysical aspects.

Underwater Mining Institute

Oct. 28–30, 1984 15th Underwater Mining Institute, Madison, Wis. (J. Robert Moore, Program Chairman, Univ. of Texas at Austin, Marine Science Institute, 200 East 26 1/2 St., Austin, TX 78705; tel.: 512-471-4816.)

The technical program will include presentations on development of real-time in situ marine minerals analysis system; tectonic setting of the Juan de Fuca sulfide deposits; recent National Oceanic and Atmospheric Administration studies of several vent sites on the Juan de Fuca ridge; use of seafloor sulfide data in exploring for sulfide deposits on land; new marine mining research and exploration programs; the continuous seafloor sediment-assay system; ground truth confirmation; and phosphate resource potential in Onslow Bay, North Carolina continental shelf.

Dallas Peck, director of the U.S. Geological Survey, will present the keynote address, entitled "Marine Minerals Research in the Exclusive Economic Zone."

Geophysical Year

A date at the end of an entry indicates the issue of *Eos* in which a full meeting announcement was run.

A list of abbreviations used in the Geophysical Year calendar appears at the end of the calendar.

Future ACU Meetings

Fall Meetings

Dec. 3–7, 1984, San Francisco
(Abstracts due mid-September 1984)

Dec. 9–13, 1985, San Francisco
(Abstracts due mid-September 1985)

Spring Meetings

May 27–31, 1985, Baltimore
(Abstracts due early March 1985)

Regional Meetings

Pacific Northwest Regional Meeting
September 7–8, 1984, Corvallis, Oregon
(Abstracts due August 1, 1984)

Front Range Branch Hydrology Days
April 16–18, 1985, Fort Collins, Colorado
(Abstracts due December 31, 1984 for professional hydrologists; February 15, 1985 for students)

Chapman Conferences

The Magnetospheric Polar Cap
August 6–9, 1984, Fairbanks

Vertical Crustal Motion:
Measurement and Modeling
October 22–25, 1984, Harpers Ferry, W. Va
(Abstracts due August 1, 1984)

1984

July 18–20 Seismic Deconvolution Workshop, Vail, Colo. Sponsor: SEG. (Orest Treitel, Amoco Production Co., Research Center, P.O. Box 591, Tulsa, OK 74102; tel.: (918) 581-1984.)

July 19–25 Symposium on Wave Breaking, Turbulent Mixing, and Radio Probing of the Ocean Surface, Sendai, Japan. (O. M. Phillips, Dept. of Earth and Planetary Sciences, John Hopkins Univ., Baltimore, MD 21218; tel.: 301-338-7036.)

July 21–28 Eighth World Conference on Earthquake Engineering, San Francisco, Sponsor: Earthquake Engineering Research Institute. (J. Penzien, Earthquake Engineering Research Institute, 2620 Telegraph Ave., Berkeley, CA 94704; tel.: 415-540-9572.)

July 23–27 Eastern Regional Groundwater Conference, Newton, Mass. Sponsor: National Water Well Assoc. Technology Div. (Alice Vickerman, National Water Well Assoc., 500 W. Wilson Bridge Rd., Worthington, OH 43085; tel.: 614-846-9355.) (June 12, 1984.)

July 23–25 Summer Computer Simulation Conference, Boston, Mass. Sponsor: Society for Computer Simulation. (W. D. Wade, 1984 SCSC Program Chairman, Wade Engineering P.C., P.O. Box 849, Huntington, NY 11743; tel.: 516-271-6075.) (June 19, 1984.)

July 23–27 11th International Symposium on Urban Hydrology, Hydraulics, and Sediment Control, Lexington, Ky. Sponsor: Univ. of Kentucky. (E. Baden, Coordinator, Office of Continuing Engineering Education, 223 Transportation Research Bldg., Univ. of Kentucky, Lexington, KY 40506–0043; tel.: 606-257-3972.) (Nov. 15, 1983.)

July 23–27 International Symposium on Challenges in African Hydrology and Water Resources, Harare, Zimbabwe. Sponsors: IAHS, UNESCO, WHO. (Zimbabwe Conference Board, P.O. Box A585 Avondale, Harare, Zimbabwe; tel.: 308222; telex: 4–285 ZW.) (June 19, 1984.)

July 24–26 Water Rights Specialty Conference, Flagstaff, Ariz. Sponsors: Ground Water Committee and Surface Water Committee of the ASCE Irrigation and Drainage Division. (Kenneth G. Renard, Southwest Watershed Research Center, 2000 E. Allen Rd., Tucson, AZ 85719; tel.: 602-629-6381.)

July 24–26 Short Course on Numerical Methods in Seismo and Engineering, Ashurst, Southampton, England. Sponsor: Computational Mechanics Institute. (Computational Mechanics Center, Ashurst Lodge, Ashurst, Southampton SO4 2AA, England.) (July 17, 1984.)

July 26–27 A Joint Workshop of the Committee on Climatic Changes and the Ocean and the Joint Scientific Committee for World Climate Research. Paris, France. (O. M. Phillips, Dept. Earth and Planetary Sciences, John Hopkins Univ., Baltimore, MD 21218; tel.: 301-338-7036.)

July 29–31 Conference on Educational Prerequisites for Water Resources Management, Baton Rouge, La. Sponsor: Universities Council on Water Resources. (Yacov Haimes, Chairman, Systems Engineering Dept., Case Western Reserve Univ., Cleveland, OH 44106; tel.: 216-368-4492.) (June 12, 1984.)

July 30–August 2 Seminar on Water Management Practices, Zaria, Nigeria. Sponsors: International Assoc. for Hydraulic Research and UNESCO. (Gunnar Lindh, Dept. of Water Resources Engineering, Lund Institute of Technology, Box 725, S-220 07 Lund, Sweden.) (Dec. 6, 1983.)

July 30–August 3 Eurogeophysics Assembly, Lausain-Le-Neuve, Belgium. Sponsor: European Geophysical Society. (G. M. Brown, Dept. of Physics, Univ. College of Wales, Aberystwyth, Wales, U.K.) (Dec. 29, 1983.)

July 31–Aug. 3 Fourth International Symposium on Stochastic Hydraulics, Univ. of Illinois, Urbana-Champaign. Sponsors: IAHR and AGU. (Ben C. Yen, Wilson H. Tang, or Glenn E. Stout, Dept. of Civil Eng., Univ. of Illinois, 208 N. Romine St., Urbana, IL 61801; tel.: 217-333-0187 or 333-0536.) (Nov. 8, 1983.)

July 31–August 3 Workshop on Fission Track Dating, Troy, N. Y. Sponsors: General Electric R&D Lab., SUNY at Albany, and Rensselaer Polytechnic Institute. (Donald S. Miller, Dept. of Geology, Rensselaer Polytechnic Institute, Troy, NY 12181.)

Aug. 4–14 27th International Geological Congress, Moscow, USSR. Sponsors: USSR National Committee for Geology, IUGS, Organizing Committee of the 27th IGC, Institute of the Lithosphere, 22, Staromonetnyi, Moscow, 109180, USSR.)

Aug. 6–9 Chapman Conference on the Magnetospheric Polar Cap, Fairbanks, Alaska. Sponsor: AGU. (Polar Cap Meeting, AGU, 2000 Florida Ave., N.W., Washington, DC 20009.) (Jan. 24, 1984.)

Aug. 12–16 International Conference on the Occurrence, Properties, and Utilization of Natural Zeolites, Budapest, Hungary. Sponsor: Hungarian Academy of Sciences. (J. Egelhardt, Secretary, Zeolite '85, Central Research Institute for Chemistry, Hungarian Academy of Sciences, H-1525 Budapest, P.O. Box 17, Hungary.) (June 19, 1984.)

Aug. 12–17 20th Annual AWRA Conference and Symposium, Washington, D. C. Cosponsor: AGU. (Kenneth B. Reid, Executive Director, American Water Resources Assoc., 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814; tel.: 301-493-8600.) (Aug. 16, 1983.) (June 26, 1984.)

Aug. 13–17 Gordon Research Conference on Chemical Oceanography, Meriden, N. H. Chairman: William Sackett. (Alexander M. Crutchfield, Director, Gordon Research Conferences, Univ. of Rhode Island, Kingston, RI 02881–0801; tel.: 401-783-4011.) (June 26, 1984.)

Aug. 13–17 12th International Laser Radar Conference, Aix-en-Provence, France. Sponsors: IAMAP and AMS. (C. Megie or J. P. Granier, Service D'Aeronomie du CNRS, 12th International Laser Radar Conference, BP 3, 91370 Verrieres le Buisson, France.) (Nov. 8, 1983.)

Aug. 14–17 Specialty Conference on Water for Resource Development, Coeur d'Alene, Idaho. Sponsor: Hydraulics Division of ASCE. (Harry Tovell, American Society of Civil Engineers, 345 E. 47th St., New York, NY 10017–2398; tel.: 212-705-7496.)

Aug. 15–17 Conference on Practical Applications of Groundwater Models, Columbus, Ohio. Sponsors: National Water Well Assoc., International Groundwater Modeling Center (Hund Nielsen, Conference Coordinator, National Water Well Assoc., 500 West Wilson Bridge Rd., Worthington, OH 43085, tel.: 614-846-9355.) (June 26, 1984.)

Aug. 19–25 Pathways and Future Directions for Environmental Data and Information Users, Denver, Colo. Sponsor: NOAA, ISIS, Incorporated. P.O. Box 2947, Springfield, VA 22152.) (June 5, 1984.)

Aug. 20–21 Gordon Research Conference on Organic Geochemistry, Plymouth, N. H. Chairman: Keith Kvenvolden. (Alexander M. Crutchfield, Director, Gordon Research Conferences, Univ. of Rhode Island, Kingston, RI 02881–0801; tel.: 401-783-4011.) (June 26, 1984.)

Aug. 21–29 International Radioloo Symposium '84 (IRS), Perugia, Italy. Sponsor: IAMAP Radiation Commission. (Giorgio Fiocco, Chairman, IRS '84, Dipartimento di Fisica, Citta Universitaria, 00185 Rome, Italy; telex: INFNRO 610257.)

Aug. 22–26 Field Conference on Open System Behavior in Magmatic Evolution: Petrological, Geochemical, and Geophysical Constraints, Taos, N. Mex. Sponsor: Institute for the Study of Earth and Man. (Mike Dungan, Dept. of Geological Sciences, Southern Methodist Univ., Dallas, TX 75275; tel.: 214-692-2750.) (Jan. 17, 1984.)

Aug. 26–29 Geothermal Resources Council 1984 Annual Meeting, Reno, Nev. (Geothermal Resources Council, P.O. Box 1350, Davis, CA 95617; tel.: 916-758-2360.) (Feb. 7, 1984.)

Aug. 26–31 Seventh Australian Geological Convention, Sydney, Australia. Sponsor: Geological Society of Australia. (Secretary 7 ACC, P.O. Box 383, North Ryde, NSW, Australia 2113.) (Nov. 29, 1983.)

Aug. 27–29 Conference on the Impact of Mining on Groundwater, Denver, Colo. Sponsor: National Water Well Assoc. (David Nielsen, National Water Well Assoc., 500 W. Wilson Bridge Rd., Worthington, OH 43085.) (July 17, 1984.)

Aug. 27–31 Seventh IAHR Symposium on Ice, Hamburg, Germany. (J. Schwarz, Ice Engineering Div., Hamburgische Schiffbau-Versuchsanstalt GmbH., P.O. Box 6009 1280, 2000 Hamburg, FRG.) (Nov. 22, 1983.)

Sept. 2–Sept. 8 General Assembly of URSI, Florence, Italy. (Vito Cappellini, IROE, Via Panzichi 64, 50127 Firenze, Italy.) (Dec. 27, 1983.)

Aug. 29–31 Symposium on the Physics of Shallow Estuaries and Bays, Miami, Fla. Sponsors: ASCE Coastal Engineering Research Council, Rosenstiel School of Marine and Atmospheric Science. (Physics of Shallow Estuaries and Bays, c/o Division of Ocean Engineering and Applied Marine Science, RSMAS, Univ. of Miami, 4600 Rickenbacker Causeway, Miami, FL 33149; tel.: 305-361-4100.)

Sept. 5–7 Quadricential Ozone Symposium, Halkidiki, Greece. Sponsors: IAMAP International Ozone Commission (IOC), Commission of the European Communities, the Academy of Athens, and WMO. (Christos S. Zerefos, Chairman, Local Organizing Committee, Physics Dept., Caupur Box 149, Univ. of Thessaloniki, Thessaloniki, Greece. Send copy of information to venue in C. D. Walshaw, Secretary, ICC, Clarendon Laboratory, Oxford Univ., Parks Rd., Oxford, OX1 3PU, U.K.)

Sept. 6–7 Conference on Stormwater and Water Quality Management Modelling, Hamilton, Ontario, Canada. (William James, Civil Engineering Dept., McMaster Univ., Hamilton, Ontario, Canada, L8S 4L7.) (June 5, 1984.)

Sept. 7–8 AGU Pacific Northwest Regional Meeting, Corvallis, Oregon. (Robert Duncan, PNACO, College of Oceanography, Oregon State Univ., Corvallis, OR 97331; tel.: 503-754-2290.)

Sept. 9–11 Penrose Conference on the Geochemistry of the Environment Near a High-Level Nuclear Waste Repository, Mt. Hood, Oreg. Sponsors: Geological Society of America, Nuclear Regulatory Commission. (David Coles, Battelle Pacific Northwest Laboratories, P.O. Box 999, Richland, WA 99352.) (May 15, 1984.)

Sept. 9–14 American Society of Photogrammetry/American Congress on Surveying and Mapping Fall Technical Meeting, San Antonio, Tex. (Monica Allain, 1984 ASP-ACSM Fall Convention, P. O. Box 8172, San Antonio, TX 78208.) (June 19, 1984.)

Sept. 10–12 Seventh Annual Madison Conference of Applied Research on Municipal and Industrial Wastes, Madison, Wis. (Philip R. O'Leary, Dept. of Engineering and Applied Science, Univ. of Wisconsin-Extension, 432 North Lake St., Madison, WI 53706; tel.: 608-262-0393.)

Sept. 10–12 Oceans 84 Conference and Exhibition, Washington, D. C. Sponsors: Marine Technology Society, AGU, and Institute of Electrical and Electronics Engineers, Oceanic Engineering Society. (Oceans 84 Technical Program Committee, 1730 M St. N.W., Suite 412, Washington, DC 20036.) (Nov. 29, 1983.)

Sept. 10–14 International Symposium on Hydrochemical Balances of Fresh Water Systems, Stockholm/Uppsala, Sweden. Sponsors: Swedish Natural Science Research Council, UNESCO, and IAHS. (A. Falkenmark, Exec. Sec. NFRS, Comm. for Hydrology, Box 6711, S-11385 Stockholm, Sweden.)

Sept. 11–12 Symposium on Water for Human Consumption, New Orleans, La. Sponsor: Louisiana World Exposition. (International Water Symposia Series, Louisiana World Exposition Inc., P. O. Box 11044, New Orleans, LA 70148–1044.) (July 3, 1984.)

Sept. 12–14 Seminar on Degradation, Retention, and Dispersion of Pollutants in Groundwater, Copenhagen, Denmark. Sponsor: International Assoc. on Water Pollution Research and Control. (Erik Arvin, Dept. of Environmental Engineering, Building 115C, Technical Univ. of Denmark, DK-2800 Lyngby, Denmark.) (Dec. 13, 1983.)

Sept. 13–14 15th Annual Conference of the Illinois Dept. of Energy and Natural Resources, Chicago. (Elizabeth Johnson, Dept. of Energy and Natural Resources, 325 W. Ad-

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ams St., Room 300, Springfield, IL 62706, tel.: 217-785-2800.)

Sept. 13–14 Symposium on New and Innovative Concepts for **Meeting Our Water Needs,** New Orleans, La. Sponsor: Louisiana World Exposition. (International Water Symposia Series, Louisiana World Exposition Inc., P.O. Box 1984, New Orleans, LA 70158–1984.) (July 3, 1984.)

Sept. 19–21 Short Course on **Computational Methods in Urban Hydrology and Stormwater Management,** University Park, Pa. Sponsor: The Pennsylvania State Univ. (David Kibler, Penn State Univ., 212 Sackett Building, University Park, PA 16802; tel.: 814-863-0086.)

Sept. 20–21 **International Symposium on Environmental Pollution,** Site To Be Announced. (V. M. Bhatnagar, Box 1779, Cornwall, Ontario K6H 5V7, Canada.)

Sept. 24–25 **Petroleum and Natural Gas Markets Conference,** Calgary, Alberta. Sponsors: Canadian Energy Research Institute, Calgary Chamber of Commerce. (Shane Streifel, Conference Director, Canadian Energy Research Institute, 3512 33rd St. NW, Calgary, Alberta, T2L 2A6, Canada; tel.: 403-282-1231.)

Sept. 24–25 Seminar: Enhanced **Biological Removal of Phosphorus From Wastewater,** Paris, France. Sponsor: International Assoc. on Water Pollution Research and Control. (Michel Florentz, Phosphorus Seminar, Anjou-Recherche, 52, Rue d'Anjou, 75384 Paris Cedex 08, France; tel.: 266-91-50; telex: Genearx 280 332 F.) (Sept. 6, 1983.)

Sept. 24–26 **International Water Well Exposition,** Las Vegas, Nev. Sponsor: National Water Well Assoc. (National Water Well Assoc., 500 W. Wilson Bridge Rd., Worthington, OH 43085; tel.: 614-846-9355.)

Sept. 24–28 SLEADS (Salt Lakes, Evaporites, Aeolian Deposits) Workshop on **Cenozoic Salt Lakes and Arid Zone** Hydrology, Geochemistry, Stratigraphy, and Paleo-environments, Mallacoota, New South Wales, Australia. Sponsor: the Australian National Univ. (J. M. Bowler, Dept. of Biogeography and Geomorphology, Research School of Pacific Studies, Australian National Univ., GPO Box 4, Canberra 2601, Australia.) (March 27, 1984.)

Sept. 26–28 Seventh National **Groundwater Quality** Symposium, Las Vegas, Nev. Sponsor: National Water Well Assoc. (NWWA, 500 W. Wilson Bridge Rd., Worthington, OH 43085; tel.: 614-846-9355.)

Sept. 26–29 Symposium on the **Quaternary of Virginia,** Charlottesville, Va. Sponsor: Virginia Division of Mineral Resources. (S. O. Bird, Virginia Division of Mineral Resources, Box 3667, Charlottesville, VA 22903; tel.: 804-293-5121.) (June 26, 1984.)

Sept. 28–29 Tectonic Geomorphology—15th **Annual Geomorphology Symposium,** Binghamton, N.Y. Organizers: Marie Morisawa and John Hack. (Marie Morisawa, Dept. of Geological Sciences, SUNY, Binghamton, NY 13901; tel.: 607-798-2615.)

Oct. 1–5 International Symposium on Recent Investigations in the **Zone of Aeration,** Munich, FRG. Sponsor: Technical Univ. of Munich. (P. Udluft, RIZA Symposium, Institut für Wasserchemie der TU München, Marchioninistr. 17, D-8000 Munich 70, FRG.) (Dec. 29, 1983.)

Oct. 1–6 **European Seismological Commission,** Moscow. (Organizing Committee, ESC, Soviet Geophysical Committee, Molodezhnaya 3, 117 296 Moscow, USSR.)

Oct. 2–4 1984 **Rocky Mountain Coal Symposium,** Bismarck, N. Dak. Sponsor: North Dakota Geological Society. (Robert Houghton, U.S. Geological Survey, 821 E. Interstate Ave., Bismarck, ND 58501; tel.: 701-255-4011.)

Oct. 3–5 1984 **Arctic Science Conference** (35th Alaska Science Conference), Anchorage. Alaska. Sponsor: AAAS Arctic Division. (John Davies, P.O. Box 80271, Fairbanks, AK 99708; tel.: 907-474-7371.) (May 1, 1984.)

Oct. 3–5 Symposium on **Meteorology and Oceanography of Northern High Latitudes,** Anchorage, Alaska. Sponsors: American Meteorological Society and AAAS. (Stuart Bigler, National Weather Service, 701 C St., P.O. Box 23, Anchorage, AK 99513.) (March 6, 1984.)

Oct. 8–10 18th Annual **Assoc. of Earth Science Editors Conference,** Portland, Oreg. (Assoc. of Earth Science Editors, 4220 King St., Alexandria, VA 22302.)

Oct. 8–11 **World Conference on Remote Sensing,** Bayreuth, FRG. Sponsors: Univ. of Bayreuth, Texas Christian Univ. Center for Remote Sensing and Energy Research, and International Society of Toxicological and Environmental Chemists. (Leo W. Newland, Director, Environmental Sciences Program, Texas Christian Univ., Fort Worth, TX 76129; tel.: 817-921-7271.) (Feb. 7, 1984.)

Oct. 9–12 16th Annual Meeting of the **Division for Planetary Sciences of the American Astronomical Society,** Kailua-Kona, Hawaii. Sponsor: The Hawaii Institute of Geophysics and the Institute for Astronomy of the Univ. of Hawaii. (Tom McCord, Planetary Geosciences Div., Hawaii Institute of Geophysics, Univ. of Hawaii, 2525 Correa Road, Honolulu, HI 96822.) (April 24, 1984.)

Oct. 10–12 **Seismological Society of America Eastern Section 56th Annual Meeting,** St. Louis, Mo. (Robert B. Herrmann, Dept. of Earth and Atmospheric Sciences, St. Louis Univ., P.O. Box 8099, St. Louis, MO 63156; tel.: 314-658-3120.)

Oct. 10–13 **New Mexico Geological Society** 35th Annual Field Conference, Taos, N. Mex. (R. Riecker, General Chairman, Los Alamos National Laboratory, Mail Stop D46, Earth and Space Sciences Div., Los Alamos, NM 87545.) (Nov. 1, 1983.)

Oct. 10–13 **Symposium: World Water Watch,** New Orleans, La. Sponsor: Louisiana World Exposition. (International Water Symposia Series, Louisiana World Exposition Inc., P.O. Box 1984, New Orleans, LA 70158–1984.) (July 3, 1984.)

Oct. 13–16 **Conference on the Origin of the Moon,** Kona, Hawaii. Sponsors: Lunar and Planetary Institute, Div. for Planetary Sciences of the American Astronomical Society. (Pam Jones, Lunar and Planetary Institute, 3303 NASA Road 1, Houston, TX 77058.) (June 12, 1984.)

Oct. 15–17 **First Multidisciplinary Conference on Sinkholes,** Orlando, Fla. Sponsors: Florida Sinkhole Research Institute, Univ. of Central Florida. (Barry Beck, Director, Florida Sinkhole Research Institute, College of Engineering, Univ. of Central Florida, Orlando, FL 32816; tel.: 305-275-2043.)

Oct. 15–19 Seminar on **Interactive Color Graphics for Environmental Resource Management,** Ithaca, N.Y. Sponsor: Cornell Univ. (Diane Banfield, Program Coordinator, Cornell Univ., Box 423 B12 Ives Hall, Ithaca, NY 14853; tel.: 607-256-4987.)

Oct. 15–21 **IGCP Project 198: Evolution of the Northern Margin of Tethys,** Bratislava, Czechoslovakia. Sponsor: International Geological Correlation Programme. (Alan Nairn, ESRI, Univ. of South Carolina, Columbia, SC 29208.)

Oct. 16–18 **Statistics Symposium on National Energy Issues,** Seattle, Wash. (Robert Kinnison, Statistics Section, Pacific Northwest Laboratory, P.O. Box 999, Richland, WA 99352.)

Oct. 16–19 International Symposium on **Lake and Watershed Management:** Local Involvement, Mt Alee, N.J. Sponsor: North American Lake Management Society. (Harry Gibbons, Jr., Dept. of Civil and Environmental Engineering, Washington State Univ., Sloan Hall 141, Pullman, WA 99164–2912.) (March 6, 1984.)

Oct. 17–19 **AIPG** Annual Meeting, Orlando, Fla. (Bobby J. Timmons, General Chairman, Timmons Associates, P.O. Box 50606, Jacksonville, FL 32250; tel.: 904-246-1533.)

Oct. 17–19 CRREL/ARO Workshop on the **Interaction of Radar with the Seasonal Snow Cover,** Cold Regions Research and Engineering Laboratory, Hanover, N. H. *Sponsors:* CRREL, AGU Hydrology Section. (S. F. Colbeck, CRREL, 72 Lyme Road, Hanover, NH 03755.)

Oct. 22–26 Chapman Conference on **Vertical Crustal Motion: Measurement and Modeling,** Harpers Ferry, W. Va. *Sponsor:* AGU. (Vertical Motion Meeting, AGU, 2000 Florida Ave., N.W., Washington, DC 20009; telephone 202-462-6903 or toll-free 800-424-2488.)

Oct. 24–26 Short Course on **Engineering and Economic Assessment of Geothermal Resources,** *San Francisco,* Ca. Sponsor: Geothermal Resources Council. (Grace Mata, Geothermal Resources Council, P.O. Box 1350, Davis CA 95617–1350; tel.: 916-758-2360.)

Oct. 28–30 15th **Underwater Mining Institute,** Madison, Wis. (J. Robert Moore, Program Chairman, Univ. of Texas at Austin, Marine Science Institute, 200 East 26 1/2 St., Austin, TX 78705; tel.: 512-471-4816.)

Oct. 29–30 Conference on **Methods for Evaluation of Groundwater Contamination Sites,** East Lansing, Mich. Sponsors: Michigan Dept. of Natural Resources, Michigan State Univ., USGS. (David Hamilton, Michigan Dept. of Natural Resources, Stevens T. Mason Building, Box 30028, Lansing, MI 48909.)

Oct. 29–31 **Conference on Geopotential Research Mission (GRM) Science,** College Park, Md. Sponsor: National Aeronautics and Space Administration. (L. Walter, Code EE-8, NASA Headquarters, Washington, DC 20546; tel.: 202-453-1675.)

Oct. 29–31 Symposium on **Groundwater: The Unseen Crisis,** Austin, Tex. Sponsors: Texas A & M University, University of Texas at Austin. (Ernest T. Smerdon, Center for Research in Water Resources, The Univ. of Texas at Austin, Building 119, 10100 Burnet Road, Austin, TX 78758–4497; tel: 512-835-3112.)

Oct. 29–31 Symposium on **Lunar Bases and Space Activities of the 21st Century,** Washington, D.C. *Sponsor: National Aeronautics* and Space Administration. (Michael Duke, NASA Johnson Space Center, Houston, TX 77058; tel.: 713-483-4461.)

Oct. 30–Nov. 3 Symposium on Relationships Between **Climate of China and Global Climate**—*Past, Present, and Future,* Peking, China. Sponsors: Academia Sinica, International Assoc. of Meteorology and Atmospheric Physics (IAMAP), American Meteorological Society. (Jih-Ping Chao, Institute of Atmospheric Physics, Academia Sinica, Beijing, China.) (March 27, 1984.)

Oct. 31–Nov. 7 **Regional Assembly of IASPEI,** Hyderabad, India. (Mohan L. Gupta, Organizing Committee, IASPEI Regional Assembly, National Geophysical Research Institute, Hyderabad-500 007, India; telex: 155-478 NGRI IN; cable: Geophysics.) (Aug. 23, 1983.)

Nov. **Mexican Geophysical Union Annual** Meeting, La Paz, Baja California Sur, Mexico. (Union Geofisica Mexicana, A.C., Comite Organizador Reunion 1984, Apartado Postal 1805, Ensenada 22800, B.C.N. Mexico.) (July 3, 1984.)

Nov. 5–8 **GSA** Annual Meeting, Reno, Nev. (Jean Latulippe, GSA, P.O. Box 9140, Boulder, CO 80301; tel.: 303-447-2020.)

Nov. 8–9 **Illinois Lake and Watershed Management** Conference, Springfield, Ill. Sponsors: Univ. of Illinois Water Resources Center, AWRA Illinois section, North American Lake Management Society. (Glenn Stout, Water Resources Center, Univ. of Illinois at Urbana-Champaign, 2535 Hydrosystems Laboratory, 208 North Romine St., Urbana, IL 61801; tel.: 217-333-0536.) (June 12, 1984.)

Nov. 11–16 Engineering Foundation **Conference on Groundwater Contamination,** Santa Barbara, Calif. Sponsors: The Engineering Foundation, Universities Council on Water Resources. (Engineering Foundation, 345 E. 47th St., New York, NY 10017; tel.: 212-705-7835.)

Nov. 12–17 **Water for South Africa,** Johannesburg, South Africa. Sponsors: National Water Well Assoc. and the Borehole Water Assoc. of Southern Africa. (David M. Nielsen, Conference Coordinator, NWWA, 500 W. Wilson Bridge Rd., Worthington, OH 43085; tel.: 614-846-9355.) (Dec. 13, 1983.)

Nov. 13 Conference on **Water Reuse and Desalination,** Johannesburg, South Africa. Sponsor: National Water Well Assoc. (Pat Alcorn, NWWA, 500 W. Wilson Bridge Rd., Worthington, OH 43085; tel.: 614-846-9355.) (May 29, 1984.)

Nov. 13–18 **Ophiolites Through Time,** Nancy, France. (Jacqueline Desmons, Université de Nancy I, Faculté des Sciences, Laboratoire de Pétrologie, B.P. no. 239, F-54506 Vandoeuvre-lès-Nancy Cedex, France.) (June 26, 1984.)

Nov. 14–15 **Coastal Zone and Continental Shelf Conflict Resolution,** Cambridge, Mass. Sponsor: Massachusetts Institute of Technology Sea Grant Program. (T. Z. Henderson, MIT Sea Grant Information Center, 77 Massachusetts Ave., Building E38-301, Cambridge, MA 02139; tel.: 617-253-7041.)

Nov. 26–30 WMO Technical Conference on **Urban Climatology and Its Applications With Special Regard to Tropical Areas,** Mexico City. *Sponsors: World Meteorological Organization,* World Health Organization. (T. R. Oke, c/o World Climate Program Dept., World Meteorological Organization, 41, Giuseppe-Motta, Case postale No. 5, CH-1211 Geneva 20, Switzerland.) (June 12, 1984.)

Nov. 26–30 *Symposium on the Scientific* **Basis for Nuclear Waste Management,** Boston, Mass. Sponsor: Materials Research Society. (John Stone, E. I. du Pont de Nemours and Co., Savannah River Laboratory, Aiken, SC 29808.) (May 8, 1984.)

Nov. 27–30 Thirtieth Annual *Conference on* **Magnetism and Magnetic Materials,** San Diego, Calif. Sponsors: American Institute of Physics, Magnetics Society of IEEE. (John Scott, American Institute of Physics, 335 East 45th St., New York, NY 10017.) (June 5, 1984.)

Dec. 3–7 **AGU Fall Meeting,** San Francisco. (Meetings, AGU, 2000 Florida Ave., N.W., Washington, DC 20009.)

Dec. 16–21 **International Chemical Congress of Pacific Basin Societies,** Honolulu, Hawaii. Sponsors: ACS, Chemical Institute of Canada, and Chemical Society of Japan. (PAC CHEM '84, *Meetings and Divisional* Activities Dept., ACS, 1155 16th St., N.W., Washington, DC 20036; tel.: 202-872-4396; PAC CHEM '84, Chemical Institute of Canada, 151 Slater St., Suite 906, Ottawa, Ontario K1P 5H3, Canada; tel.: 613-233-5623; PAC CHEM '84, Chemical Society of Japan, 1–5, Kanda-Surugadai, Chiyoda-ku, Tokyo 101, Japan; tel.: 03–292–6161.) (Sept. 13, 1983.)

Dec. 17–21 **Tectonic Studies Group 15th Annual General Meeting,** Swansea, U.K. Sponsor: University College of Swansea. (Richard Lisle, Dept. of Geology, University College, Swansea SA2 8PP, United Kingdom.)

Dec. 28–31 Fourth International Conference on **Applied Numerical Modeling,** Tainan, Taiwan. (S. Y. Wang, School of Engineering, Univ. of Mississippi, University, MS 38677; tel.: 601-232-7219.)

1985

Jan. 7–12 17th International *Congress on* **Hydrogeology of Rocks of Low Permeability,** Tucson, Ariz. Sponsors: International Assoc. of Hydrogeologists, AGU. (E. S. Simpson, Dept. of Hydrology and Water Resources, College of Engineering, Univ. of Arizona, Tucson, AZ 85721.)

February International Symposium on **Recent Crustal Movement,** Maracaibo, Venezuela. Sponsor: International Assoc. of Geodesy. (Heinz Henneberg, Apartado 6, Maracaibo, Venezuela; telex: 61263 CAMER VC.)

Feb. 21–22 Sixteenth Annual Conference on **Erosion Control Practices and Research,** San Francisco. Sponsor: International Erosion Control Assoc. (Gerry Hester, Program Committee Chairman, International Erosion Control Assoc., Inc., P.O. Box 807, Freedom, CA 95019.) (May 29, 1984.)

March 10–15 American Society of **Photogrammetry** and American Congress on **Surveying and Mapping** National Meeting, Washington, D. C. (Willard A. Kuncis, 4415 Jensen Pl., Fairfax, VA 22032; tel.: 703-425-8790.)

March 11–15 Sixteenth **Lunar and Planetary Science Conference,** Houston, Tex. Sponsors: Lunar and Planetary Institute, AGU, NASA Johnson Space Center, Division for Planetary Science of the American Geological Society of America, Meteoritical Society. (Pamela Jones, Conference Administrator, Lunar and Planetary Institute, 3303 NASA Road 1, Houston, TX 77058; tel.: 713-486-2150.)

March 18–21 International Conference on **Integral Methods in Science and Engineering,** Arlington, Tex. Sponsor: Univ. of Texas at Arlington. (Fred R. Payne, A.E. Dept., UT-Arlington, 76019; tel.: 817-273-2071.)

April 1–4 **European Union of Geosciences** Biennial Meeting, Strasbourg, France. (Organizing Committee, Dept. of Earth Sciences, Univ. of Cambridge, Downing St., Cambridge CB2 3EQ, U.K.)

April 14–19 GSA Penrose Conference on Geomorphic and Stratigraphic Indicators of **Neogene-Quaternary Climatic Change** in Arid and Semiarid Environments, Lake Havasu City, Ariz. Conveners: John Dohrenwend, USGS; Steve Wells and Les McFadden, Univ. of New Mexico. (John Dohrenwend, U. S. Geological Survey, MS 941, 345 Middlefield Rd., Menlo Park, CA 94025.)

April 16–19 First International Symposium on **Precise Positioning with the Global Positioning System,** Rockville, Md. Sponsors: IAG, IUGG, Defense Mapping Agency, NOAA. (Positioning with GPS-1985, White Flint Mall, Post Office Box 2095, Kensington, MD 20895.)

April 16–18 Fifth Annual **AGU Front Range Branch Hydrology Days,** Fort Collins, Colo. (H. J. Morel-Seytoux, *Dept. of Civil Engineering,* Colorado State Univ., Fort Collins, CO 80523; tel.: 303-491-5448 or 8549.) (July 17, 1984.)

April 18–20 **Continental Extensional Tectonics,** Durham, England. Sponsor: Geological Society. (*J. F. Dewey, Dept. of Geological Sciences,* Durham University, Durham DH1 3LE, England.)

April 21–26 Third International Symposium on the **North American Vertical Datum,** Rockville, Md. Sponsors: IAG, NOAA, *National Geodetic Survey.* (*Gary M. Young, Asst.* Director, NAVD Symposium 85, White Flint Mall, P. O. Box 2065, Kensington, MD 20895; tel.: 301-443-8587.)

April 28–May 1 International Conference on **Arctic Water Pollution Research:** *Applications of Science and Technology,* Yellowknife, Northwest Territories, Canada. Organizer: Canadian National Committee, International Assoc. on Water Pollution Research and Control. (K. Charbonneau, National Research Council of Canada, Montreal Road Laboratories, Ottawa K1A OR6, Canada; tel.: 613-993-9009.)

April 30–May 1 Symposium on **Watershed Management,** Denver, Colo. Sponsor: American Society of Civil Engineers. (E. Bruce Jones, President, Resource Consultants, Inc., P.O. Box Q, Fort Collins, CO 80522.) (May 1, 1984.)

May Symposium on **Hydrothermal Alteration and Geothermal Brine Chemistry, Processing, and Mineral Recovery,** Palm Springs, Calif. Sponsor: Geothermal Resources Council. (Grace Mata, Geothermal Resources Council, P.O. Box 1350, Davis, CA 95617–1350; tel.: 916-758-2360.)

May 6–10 Symposium on **Vertical Motion in the Equatorial Upper Ocean and Its Effects on Living Resources and the Atmosphere,** Paris, France. Sponsors: Scientific Committee on Oceanic Research, UNESCO. (David Halpern, NOAA PMEL, 7600 Sand Point Way NE, Seattle, WA 98115.)

May 13–18 Third **JECSS (Japan and East China Seas Study) Workshop,** Tsukuba University, Japan. Sponsors: Japan Marine Science and Technology Center, Oceanographical Society of Japan, Japanese-French Oceanographical Society. (Takashi Ichiye, Dept. of Oceanography, Texas A & M Univ., College Station, TX 77843.)

May 27–31 **AGU Spring Meeting,** Baltimore, Md. (Meetings, AGU, 2000 Florida Ave., N.W., Washington, DC 20009.)

May 27–June 1 **Fifth International Coral Reef Congress,** Tahiti, French Polynesia. (Organising Committee, Coral Reef Congress, B.P. 562 Papeete, Tahiti, French Polynesia.)

Summer Colloquium on Comparative Study of **Magnetospheric Systems,** France. (Dominique Le Quéau and Rene Manfler-Pedersen, DASOP, Observatoire de Meudon, F 92195, Meudon Principal Cedex, France; Telex: 200 590 CNET OBS.) (Aug. 9, 1983.)

June Second International Conference on **Soil Dynamics and Earthquake Engineering,** on board the Queen Elizabeth II. Sponsor: Computational Mechanics Institute. (C. A. Brebbia, Computational Mechanics Institute, Ashurst Lodge, Ashurst, Southampton SO4 2AA England.)

June 4–7 International Conference on **Mafic Dyke Swarms,** *Mississauga, Ontario,* Canada. Sponsors: IUGS Commission on Tectonics, the International Lithosphere Programme, and the Geological Survey of Canada. (H. C. Halls, Erindale Campus, Univ. of Toronto, Mississauga, Ontario L5L 1C6, Canada; tel.: 416-828-5363.)

June 9–15 **IWRA** Fifth World Congress, Brussels, Belgium. (Fifth World Congress On Water Resources, Brussels International Conference Centre, Parc des Expositions, Tentoonstellingspark, B-1020 Brussels, Belgium; tel.: 32-2-478–48–60; *telex:* 23–643.) (Aug. 30, 1983.)

June 16–21 Third International Symposium on Analysis of **Seismicity and Seismic Risk,** Liblice, Czechoslovakia. (Z. Schenkova, Geophysical Institute, Bocni II, 14131 Prague 4, *Czechoslovakia.*)

June 26–28 **U.S. Symposium on Rock Mechanics,** Rapid City, S. Dak. Sponsor, South Dakota School of Mines and Technology. (Fileen Ashworth, Chairman, 26th U.S. Symposium on Rock Mechanics, Dept. of Mining Engineering, South Dakota School of Mines and Technology, Rapid City, SD 57701–3995; tel.: 605-394-2344.)

July 8–10 **International Hydrology Symposium,** Fort Collins, Colo. Sponsors: AGU Hydrology Section, International Assoc. of Hydrological Sciences, ASCE, IWRA, IAHR. (H. W. Shen, Dept. of Civil Engineering, Hydrology and Water Resources Program, Foothills Campus, Colorado State Univ., Fort Collins, CO 80523.)

July 29–Aug. 9 Tsunami 85: **International Tsunami Symposium** of the IUGG Tsunami Commission, Victoria, Canada. (Tsunami 85, P.O. Box 2207, Sidney, B.C., Canada V8L 3S8; tel.: 604-656-8343.)

August International **Workshop on Hydrologic Applications of Space Technology:** Input to Hydrologic Models and Geographic Information Systems, Fla. Sponsors: IAHS, WMO. (A. Ivan Johnson, President, IAHS International Committee on Remote Sensing and Data Transmission, 7474 Upham Court, Arvada, CO 80003.)

Aug. 5–16 IAMAP/IAPSO *Joint* Scientific Assembly on the **Large Scale Circulations of the Oceans and Atmosphere** and their Interactions, Honolulu, Hawaii. Sponsors: IAMAP, IAPSO, AGU. (AGU, 2000 Florida Ave. NW, Washington, DC 20009.)

Aug. 5–17 *Symposium on* **Magnetic Anomalies** over the Margins of Continents and Plates, Prague, Czechoslovakia. Sponsor: International Assoc. of Geomagnetism and Aeronomy. (William J. Hinze, Dept. of Geosciences, Purdue Univ., West Lafayette, IN 47907; tel.: 317-494-5982.) (Feb. 7, 1984.)

Aug. 11–15 21st Annual **AWRA Conference on Water Demand: Sharing a Limited Resource** and **Symposium on Groundwater Contamination and Reclamation,** Tucson, Ariz. Sponsor: AWRA. (Nathan Buras, Dept. of Hydrology and Water Resources, Univ. of Arizona, Tucson, AZ 85721.)

Aug. 12–16 International Conference on the **Occurrence, Properties, and Utilization of Natural Zeolites,** Budapest, Hungary. Sponsor: Hungarian Academy of Sciences. (J. Engelhardt, Secretary, Zeolite '85, Central Research Institute for Chemistry, Hungarian Academy of Sciences, H-1525 Budapest, P.O. Box 17, Hungary.) (June 19, 1984.)

Aug. 19–23 **Sixth Gondwana Symposium,** Columbus, Ohio. Sponsor: GSA. (D. Elliot, Ohio State Univ., Institute of Polar Studies, 108 Mendenhall, 125 South Oval Mall, Columbus, OH 43210.)

Aug. 19–24 **Fourth Chilean Geological Congress,** Antofagasta, Chile. Sponsor: Dept. of Geosciences, Universidad del Norte. (Organizing Committee, Fourth Chilean Geological Congress, Dept. of Geosciences, Universidad del Norte, Casilla (Box) 1280, Antofagasta, *Chile; tel.: 222040–205.*)

Aug. 19–30 **23rd General Assembly of IASPEI,** Tokyo, Japan. (Ryosuke Sato, Secretary-General of the 23rd General Assembly of IASPEI, c/o Inter Group Corp., Akasaka Yamakatsu Bldg., 8–5–32, Akasaka, Minato-ku, *Tokyo* 107, Japan; *tel.: Tokyo (03) 479-5311.*)

Aug. 23–25 **Workshop on High Temperature Geothermal Drilling,** Kailua-Kona, Hawaii. Sponsor: Geothermal Resources Council. (Grace Mata, Geothermal Resources Council, P.O. Box 1350, Davis, CA 95617–1350; tel.: 916-758-2360.)

Aug. 26–30 **International Symposium on Geothermal Energy,** Kailua-Kona, Hawaii. Sponsor: Geothermal Resources Council. (Geothermal Resources Council, P. O. Box 1350, Davis, CA 95617; tel.: 916-758-2360.)

Aug. 31–Sept. 1 Workshop on **Fractures in Geothermal Reservoirs or Geothermal Exploration,** Kailua-Kona, Hawaii. Sponsor: Geothermal Resources Council. (Grace Mata, Geothermal Resources Council, P.O. Box 1350, Davis, CA 95617–1350; tel.: 916-758-2360.)

September International Symposium *on* **Variational Methods in Geosciences,** Norman, Okla. Sponsors: Cooperative Institute for Mesoscale Meteorological Studies, Univ. of Oklahoma College of Geosciences. (Y. K. Sasaki, Univ. of Oklahoma, 815 Jenkins, Norman, OK 73019.)

Sept. 15–20 Sixth International Conference on **Basement Tectonics,** Santa Fe, N. Mex. (M. J. Aldrich, Mail Stop D462, Los Alamos National Laboratory, Los Alamos, NM 87545; tel.: 505-667-1495.)

Sept. 16–21 Symposia on **Potassic Volcanism and Etna Volcano,** Catania, Italy. Sponsor: IAVCEI. (G. Frazzetta and G. Lanzafame, Istituto Internazionale di Vulcanologia, V.le S. Margherita, 6, Catania, Italy.) (Dec. 27, 1983.)

Sept. 17–21 **AIPG** Annual Meeting, St. Paul, Minn. (Robert E. Prendergast, General Chairman, Geotechnical Engineering Corp., 1925 Oakcrest Ave., Roseville, MN 55113; tel.: 612-636-7744.)

Sept. 19–25 International Symposium on **Scientific Basis for Water Resources Management,** Jerusalem. Sponsors: Israel Assoc. of Hydrology, IAHS. (SBWRM Israel '85, The Israel Assoc. of Hydrology, P.O. Box 6381, Jerusalem, Israel.)

Oct. 9–10 International Symposium on **Management of Hazardous Chemical Waste Sites,** Winston-Salem, N. C. Sponsors: AGU, U.S. National Committee of International Assoc. of Engineering Geology, Assoc. of Engineering Geologists. (Norman Tilford, Dept. of Geology, Texas A&M Univ., College Station, TX 77843–3115; tel.: 409-845-0682.)

Oct. 10–12 Conference on **Heat and Detachment in Crustal Extension on Continents and Planets,** Sedona, Ariz. Sponsor: Lunar and Planetary Institute, USGS, GSA. (Pam Jones, LPI Projects Office, Lunar and Planetary Institute, 3303 NASA Road 1, Houston, TX 77058; tel.: 713-486-2150.)

Oct. 14–18 **Dissertation Symposium on Chemical Oceanography (DISCO),** Honolulu, Hawaii. (Neil Andersen, Director, Marine Chemistry Program, National Science Foundation, Washington, D.C. 20550.)

Oct. 21–25 International Conference on **Arid Lands: Today and Tomorrow,** *Tucson, Ariz.* Sponsors: UNESCO, Univ. of Arizona. (G. P. Nabhan, Office of Arid Land Studies, Univ. of Arizona, Tucson, AZ 85721.)

Oct. 28–31 **Geological Society of America 1985 Annual Meeting,** Orlando, Fla. (Sue Beggs, Meetings Manager, GSA, P.O. Box 9140, Boulder, CO 80301; tel.: 303-447-2020.)

Oct. 28–Nov. 1 **International Conference on Coal Science,** Sydney, Australia. Sponsor: International Energy Agency. (R. W. Hinde, Executive Secretary, CSIRO, Div. of Fossil Fuels, P.O. Box 136, North Ryde, NSW 2113, Australia.)

Dec. 9–13 **AGU Fall Meeting,** San Francisco. (Meetings, AGU, 2000 Florida Ave., N.W., Washington, DC 20009.)

AAAS American Association for the Advancement of Science
AAPG American Association of Petroleum Geologists
ACS American Chemical Society
AIPG American Institute of Professional Geologists
AMS American Meteorological Society
ASCE American Society of Civil Engineers
AWRA American Water Resources Association
GSA Geological Society of America
IAG *International Association of Geodesy*
IAGA International Association of Geomagnetism and Aeronomy
IAHR International Association for Hydraulic Research
IAHS International Association of Hydrological Sciences
IAMAP International Association of Meteorology and Atmospheric Physics
IAPSO International Association for the Physical Sciences of the Ocean
IASPEI International Association of Seismology and Physics of the Earth's Interior
IAVCEI International Association of Volcanology and Chemistry of the Earth's Interior
ICSU International Council of Scientific Unions
IUGG International Union of Geodesy and Geophysics
IUGS International Union of Geological Sciences
IWRA International Water Resources Association
MSA Mineralogical Society of America
SEG Society of Exploration Geophysicists
SEPM Society of Economic Paleontologists and Mineralogists
URSI International Union of Radio Science
WMO World Meteorological Organization

GAP

Aeronomy

0410 Pressure, density and temperature
CORRELATIONS BETWEEN THERMOSPHERIC DENSITY AND TEMPERATURE, SOLAR EUV FLUX, AND 10.7 CM FLUX VARIATIONS
A. E. Hedin (*Atmospheric Physics Branch, NASA/Goddard Space Flight Center,* Greenbelt, MD 20771)

Simultaneously measured thermospheric N_2 densities and solar EUV fluxes obtained by the AE-E satellite are compared with ground based solar 10.7 cm fluxes and calcium plage measurements. Short wavelength (coronal) EUV variations correlate better with thermospheric density than the 10.7 cm flux, although the reduction in density residuals is small. Correlation of density with a calcium plage index was somewhat worse than with 10.7. Although the overall correlation of 10.7 cm flux with EUV fluxes is high, the best fit slopes are different for short and long term variations and there are instances where the short term behavior of various EUV emissions and the 10.7 cm flux are distinctly different. For both density and EUV, a two factor formula based on daily 10.7 cm flux and a running mean of the 10.7 cm flux provides a better fit than using a daily 10.7 cm flux alone.

J. Geophys. Res., A, Paper 4A0916

0460 Tides, waves and winds
NIGHTTIME VARIATION OF THERMOSPHERIC WINDS AND TEMPERATURES OVER FRITZ PEAK OBSERVATORY DURING THE GEOMAGNETIC STORM OF MARCH 2, 1983
G. Hernandez (Aeronomy Laboratory, NOAA, Boulder, CO 80303), R.G. Roble (National Center for Atmospheric Research, Boulder, CO 80307)

Nighttime thermospheric winds and temperatures have been measured over Fritz Peak Observatory, Colorado (39.9°N, 105.5°W), with a high-resolution Fabry-Perot spectrometer during the March 2, 1983 geomagnetic storm. The winds and temperatures are obtained from the Doppler shifts and line profiles of the [OI] 15,867K (630 nm) line emission. The planetary geomagnetic index, K_p, increased abruptly from 4 to 7 during the beginning of the measuring period near 0000 UT on March 2 and remained at nearly that level throughout the night. During the early evening hours near 1900 LT (0200 UT) the zonal winds measured in both the east and west directions from Fritz Peak Observatory were westward at a speed of about 100 m s^{-1}. The westward winds increased in magnitude during the next two hours, with the wind speed east of the station reaching 400 m s^{-1} and the winds to the west of the station reaching 300 m s^{-1}. The westward winds remained at roughly these speeds until about local midnight (0700 UT) when they gradually decreased to about 50 m s^{-1} in the east, and the winds to the west of the station shifted to eastward at about 50 m s^{-1}.

The meridional winds measured in the early evening hours both to the north and south of the station were poleward at speeds ranging between 50 and 100 m s^{-1}. Near local midnight the wind measured north of the station gradually shifted to equatorward, reaching a maximum speed of about 300 m s^{-1} near 0200 LT (0900 UT) and then decreasing to about 100 m s^{-1} near dawn. The wind measured south of the station remained poleward throughout the night at speeds ranging between 25 and 100 m s^{-1}. The neutral gas temperature over Fritz Peak Observatory increased throughout the night from about 1300 to 1600°K.

Calculations made with the NCAR thermospheric general circulation model suggest that the observed winds over Fritz Peak Observatory (L = 3) are under the influence of an expanded magnetospheric convection pattern during the storm. Enhanced magnetospheric convection at midlatitudes characteristically produces westward winds during the early evening hours and a strong equatorward surge in the postmidnight winds.

J. Geophys. Res., A, Paper 4A0899

Electromagnetics

0720 Electromagnetic theory
HIGH FREQUENCY RAY PATHS IN IONOSPHERIC LAYERS WITH HORIZONTAL GRADIENTS
K. Davies (SEL/NOAA, U.S. Dept. of Commerce, Boulder, CO 80303), C. M. Rush (ITS/NTIA, U.S. Dept. of Commerce, Boulder, CO 80303)

The results of a study to determine the effects of horizontal gradients in the F2-region electron density on short-distance HF propagation paths (0-1000 km) are presented. Ray paths were obtained by employing specific models to represent the horizontal and vertical variations of the F2 region. These models permitted ray path characteristics to be expressed by algebraic relationships. The changes in ray-path characteristics with height of reflection, frequency, and azimuth are presented for gradients typically encountered on short-distance HF propagation circuits over Europe.

Rad. Sci., Paper 4S0878

0720 (Electromagnetic Theory)
INVERSION THEORY FOR ALMOST PERIODIC MEDIA
D.L. Jaggard (Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, PA 19104) and A.K. Jordan

The inversion problem for almost periodic media is considered and formulated where the almost periodic medium is characterized by discrete spatial frequencies or tones. By use of a priori knowledge and the characteristics of the scattering data, two distinct inversion methods are found for determining almost periodic profiles from scattering data. These methods correspond to the cases of widely-spaced and closely-spaced tones. The formulation is important and useful since almost periodic functions provide a convenient basis for expanding the characteristic functions of a variety of periodic, quasi-periodic, aperiodic or random media. In addition, rational function reflection data leads naturally to generalized almost periodic profiles. These concepts are illustrated by several numerical examples. (Inverse scattering, almost periodic media, profile inversion, inhomogeneous media.)

Rad. Sci., Paper 4S0924

0720 Electromagnetic Theory
ELECTROMAGNETIC SCATTERING BY HARMONICALLY EXCITED EXPANDING SURFACES AND RELATED COMPLEX RESONANCES
Dan Censor (Department of Electrical and Computer Engineering, Ben-Gurion University of the Negev, Beer Sheva 84105, Israel)

A relativistically exact iterative method is developed for scattering of electromagnetic waves by expanding surfaces. In particular, the problem of the expanding cylinder and sphere are computed. It is shown that expanding scatterers respond to harmonic excitation by radiating non-harmonic waves. These waves involve complex frequencies computed here. The method given here involves secular terms in t, therefore its validity for harmonic excitation is limited to early times. However, in the case of impulse excitation and transient scattering this problem is automatically resolved by the fact that the signal is exponentially decaying and the secular terms have no large-time effect. (Relativistic electrodynamics, scattering by time dependent objects).

Rad. Sci., Paper 4S0922

0771 Remote Sensing
COMPARISON OF WINDS, WAVES, AND TURBULENCE AS OBSERVED BY AIRBORNE LIDAR, GROUND BASED RADARS, AND INSTRUMENTED TOWER
D. D. Ellis (National Severe Storms Laboratory, 1313 Halley Circle, Norman, Oklahoma, 73069), R. J. Doviak and A. Sundara-Rajan

On June 27, 1981, two ground based Doppler radars, an airborne Doppler lidar, a tall (444m) instrumented tower, and a rawinsonde collected wind data in the Planetary Boundary Layer (PBL) in central Oklahoma. This allowed, for the first time, intercomparison of wind fields synthesized from airborne Doppler lidar data with those from dual Doppler radar data. The vertical profile of wind in the PBL measured by the radars compared favorably with the profiles measured by the tower and rawinsonde while the one obtained from lidar data differed from the other three by as much as 3 m/sec in wind speed and 18° in direction. The time dependence of differences in wind estimates from radar and lidar suggested that these discrepancies could be attributed to a Schuler resonance in the aircraft's inertial navigation system which caused an erroneous component of the aircraft velocity vector to be subtracted from the lidar radial velocities, thus creating errors in the synthesized wind speed and direction. The vertical profile of horizontal velocity fluctuations detected by the different sensing systems compared well. Also, spectra from the different sensing systems compared well in both magnitude and shape, suggesting that the lidar and radar detected similar structure in the PBL. A peak at the 4 km wavelength, evident in spectra from all sensing systems, is proposed to be caused by horizontally symmetrical cells having wavelength four times the height of the PBL in accord with theory. (Doppler radar, Doppler lidar, planetary boundary layer).

Rad. Sci., Paper 4S0923

0780 Scattering
A GEOMETRICAL THEORY OF DIFFRACTION FOR A HALF PLANE RESIDING ON THE INTERFACE BETWEEN DISSIMILAR MEDIA: TRANSVERSE MAGNETIC POLARIZED CASE
S. Dawson Cobllo (Lockheed Missiles & Space Company, Sunnyvale, CA, 94086) and L. Wilson Pearson

An asymptotic ray analysis of the diffraction of an electromagnetic plane wave by a perfectly conducting half plane that resides on the interface separating half spaces filled with dissimilar media is developed for the case where the plane of incidence is perpendicular to the edge. The diffraction problem is formulated as an integral equation whose unknown is the tangential component of electric field residing on the uncovered half of the interface plane. This integral equation is solved by using the Wiener-Hopf technique. Asymptotic analysis of the resulting diffracted fields is carried out in the angular spectral plane and ray interpretations are assigned to the asymptotic terms. In addition to geometrical optics and edge-diffracted field components, which arise in the Sommerfeld diffraction problem, a lateral wave field is found to contribute to the total (asymptotically evaluated) field. (Diffraction, interface, ray).

Rad. Sci., Paper 4S0863

0790
[illegible]

Rad. Sci., Paper [illegible]

0799 General (Ionospheric Reflection)
IMPULSE RESPONSE FOR IONOSPHERIC REFLECTION WITH A $SECH^2$ PROFILE
Lewis E. Vogler (NTIA/ITS.N2, 325 Broadway, Boulder, Colorado, 80303)

The impulse response for reflection from an ionospheric layer with a $sech^2$ electron density profile is investigated. A constant electron collision frequency is assumed, and approximate results are obtained for reflection at oblique incidence under the influence of a vertical earth's magnetic field. Fast Fourier Transform techniques are used to evaluate the impulse response, and an asymptotic expression is derived for the envelope of the response. Numerical examples are shown for some representative cases of E- and F-layer reflection. (Impulse response, ionospheric propagation).

Rad. Sci., Paper 4S0892

Geochemistry

1410 (Chemistry of the Atmosphere)
GAS- AND AQUEOUS-PHASE CHEMISTRY OF HO_2 IN LIQUID-WATER CLOUDS
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A model for reversible mass transport of HO_2 between the gas and aqueous phases of liquid-water clouds is used to examine the coupling of reaction kinetics of this species in the two phases. The Henry's law coefficient of HO_2 necessary for this analysis is evaluated by means of a thermochemical cycle involving $O_2^-(aq)$ to be $(1-3) \times 10^3$ M atm^{-1}. The mass accommodation coefficient α for uptake of HO_2 by liquid water is not known and is treated as an adjustable parameter. Results are expressed in terms of yields of $HNO_3(g)$, $H_2O_2(g)$ and $H_2O_2(aq)$ relative to the initial photochemical generation rate of OH(g). For large values of α ($\gtrsim 10^{-3}$) aqueous-phase H_2O_2 formation may be a major radical sink process, but the rate of aqueous-phase H_2O_2 production decreases strongly with $\alpha \lesssim 10^{-3}$. Substantial difference, e.g., a factor of as much as 50 in gas-phase HO_2 concentration, is found between kinetic calculations where uptake of HO_2 by cloud droplets is treated reversibly vs. irreversibly. Such differences demonstrate the need to treat the dissolution process as reversible, even for reactive free radical species. (Free radicals, cloud chemistry).

J. Geophys. Res., D, Paper 4D0467

Geodesy and Gravity

1910 Crustal movements
A MODEL FOR DEFORMATION IN LONG VALLEY, CALIFORNIA, 1980-1983*
John R. Rundle, (Geophysics Division 1541, Sandia National Laboratories, Albuquerque, NM 87185 and James H. Whitcomb

Geodetic data collected in Long Valley, California, from 1975 through 1983 define a pattern of uplift and strain which is evidently associated with a sequence of earthquakes occurring in May, 1980 and subsequent swarm activity continuing until the present. We have constructed a model to explain the deformation observed since May, 1980 in terms of inflation of two subsurface magma chambers, faulting in the south moat region of the caldera on a graben structure, and slip on the Hilton Creek fault. The most significant new feature of the model is the shallow magma chamber, at 5 km depth, located a few hundred meters to the east of the Casa Diablo hot spring area. Inflation of this chamber causes stresses which show consistency with various aspects of the seismicity in the south moat of the caldera. Calculations of stress across vertical planes over the magma chamber can be used together with failure criteria to estimate the inflation volume at which the rock layers intervening between the chamber and the surface will fail by extensional fracture.
*This work was supported by the U. S. Department of Energy under contract DE-AC04-76DP00789.

J. Geophys. Res., B, Paper 4B0376

1920 Geometric observations and methods
RADIO INTERFEROMETRIC DETERMINATION OF INTERCONTINENTAL BASELINES AND EARTH ORIENTATION UTILIZING DEEP SPACE NETWORK ANTENNAS - 1971 TO 1980
O.J. Sovers (Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109), J.B. Thomas, J.L. Fanselow, E.J. Cohen, G.H. Purcell, Jr., D.H. Rogstad, L.J. Skjerve and D.J. Spitzmesser

A series of experiments has been conducted during the last decade to develop a radio interferometry system capable of measuring crustal and rotational motions of the earth, as well as source positions for a reference frame based on compact extragalactic radio sources. With the exception of one session between Big Pine, Calif., and Westford, Mass., the observing stations have been those of NASA's Deep Space Network in California, Spain, and Australia. Approximately 2400 observations of extragalactic radio sources were made between August, 1971 and February, 1980 during 88 separate sessions. A single multiparameter fit was applied to the observed values of delay and delay rate to extract astrometric and geophysical parameters from this decade-long sequence. The fit produced estimates of 684 parameters, including station locations, radio source positions, polar motion, universal time, the precession constant, and solid earth tides. The a priori model included gravitational bending, the 1980 IAU nutation series, the 1976 IAU expressions for Greenwich mean sidereal time and precession, BIH estimates of universal time and polar motion, and monthly mean values for zenith troposphere delay. The RMS residuals were 0.52 nsec for delay and 0.30 psec/sec for delay rate. Intercontinental baseline lengths have been determined with formal uncertainties of 5 to 18 cm. Universal time and polar motion were measured at 89 epochs, with formal uncertainties (for the more recent data) of 0.5 msec for UT1 and 6 and 2 mas, respectively, for the X and Y components of polar motion. Our 1971-80 data produced an estimate of the luni-solar precession constant that is smaller than the 1976 IAU value by 3.8 mas/yr with an approximate accuracy of 1 or 2 mas/yr. The earth-tide results agree with the commonly accepted values. (Radio interferometry, intercontinental baselines, polar motion).

J. Geophys. Res., B, Paper 4B0764

Hydrology

3130 Groundwater (Convection)
SCALES FOR DOUBLE-DIFFUSIVE FINGERING IN POROUS MEDIA
T. Green (Civil and Environmental Engineering, University of Wisconsin, Madison, Wisconsin, 53706)

The influence of the double-diffusive process of fingering on vertical transport in a porous medium is examined, using a very successful model borrowed from oceanic salt-finger theory. The results suggest that fluxes associated with double-diffusive fingering may well be important, at least in regions where the porous medium is saturated. The effect of horizontal dispersion remains to be accounted for, and will probably place limits on the efficiency of the process. (Double diffusion, convection, porous media).

Water Resour. Res., Paper 4W0877

3150 Groundwater
[illegible]
[illegible] (Civil and Environmental Engineering, University of Wisconsin, Madison, Wisconsin, 53706)

Buoyant, contaminant ground water plumes occur when liquid wastes, having densities different from the ambient water, are released from various land disposal activities to e.g. landfills, infiltration lagoons. Using mass and momentum conservation equations, an analytical model for plume characteristics and behavior (namely, trajectory, concentration and boundary) is developed for steady flow in a homogeneous, isotropic aquifer. The model employs near field and far field regions to describe the plume behavior and characteristics. Solutions of the model yield dimensionless relations for the plume characteristics and behavior in each region in terms of length and concentration scales, representing the combined effects of the source buoyancy flux and size and the ambient groundwater flow and dispersion. Experimental results, from a series of tests in a homogeneous, isotropic sand medium with a salt water discharge, are in reasonable agreement with model predictions. The model results have application to field problems under similar conditions.

Water Resour. Res., Paper 4W0658

3160 Runoff and streamflow
MONTE CARLO OPTIMIZATION FOR RESERVOIR OPERATION
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A methodology that determines a probabilistic reservoir release policy using Monte Carlo Optimization is developed. For a particular streamflow sequence, the methodology determines the optimal reservoir release for each time period over the operational horizon. After repeating this procedure for a large number of synthetic streamflow sequences, an operational policy is determined utilizing the probability mass function of the optimal releases, conditioned on observable hydrologic conditions. The methodology is applied to the Mad River Basin in northern California to develop monthly reservoir release policies using reservoir storage and inflow as the observed conditioning hydrologic variables. (Reservoir operation, optimization).

Water Resour. Res., Paper 4W0819

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